THE UNIVERSITY OF ALBERTA

AN EXPERIMENTAL STUDY
OF THE EFFECT
OF TRAINING IN AUDITORY DISCRIMINATION
ON READING ACHIEVEMENT IN GRADE ONE

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "An Experimental Study of the Effect of Training in Auditory Discrimination on Reading Achievement in Grade One" submitted by Grace Velina Cosens in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

This study investigated the effect of taped training in auditory discrimination on the reading achievement and the auditory discrimination of grade one subjects who scored low in auditory discrimination. The test sample consisted of sixty children from four classrooms in two Edmonton Public Schools. Subjects were selected on the basis of scores obtained on auditory discrimination and auditory acuity tests. The experimental study involved a pretest-treatment-posttest comparison of subjects given training in auditory discrimination with subjects not given training. The treatment consisted of a four week training period from the middle of May to the middle of June. Pretest and posttest scores were obtained for oral reading, silent reading, and auditory discrimination. Intelligence tests were also administered.

An analysis of test results revealed that taped training in auditory discrimination near the close of the grade one school year resulted in improved scores on total auditory discrimination. Improvements were evident on stops and fricatives, on sounds in the final position, and on like word pairs. There was no significant improvement in oral or silent reading achievement as a result of auditory discrimination training.

A consideration of the performance of the total test population on the auditory discrimination test revealed that stops and nasals were the most difficult sounds for first graders to discriminate. Fricative-stop comparisons were also difficult, but fricatives, affricate-fricative comparisons, and semivowel-lateral comparisons were relatively easy sound constrasts to discriminate. Voiceless sounds tended to be

easier to discriminate than voiced sounds. Sounds in the final position of words were generally more difficult to discriminate than sounds in the inital or medial positions. Sounds in the medial position of words were fairly easy. Hearing similarities of speech sounds in words appeared to be an easier discriminatory task than hearing differences. There did not appear to be a strong relationship between sex, chronological age, or socio-economic status and ability to make auditory discriminations.

The results of this study indicated that auditory discrimination training near the close of the grade one year did not improve the reading achievement of pupils low in auditory discrimination. Since correlations between silent reading and auditory discrimination scores were significant, however, it was suggested that auditory training earlier in the grade one year might result in improved silent reading scores.

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The author wishes to express sincere thanks and appreciation to Dr. J. Robertson for her able supervision of this project. Grateful acknowledgement is made to Mr. D. Sawada and Mr. D. Precht for planning and programming the statistical treatment of the data.

Appreciation is also expressed for the cooperation and help of the grade one teachers whose classes were involved in this study. A special thanks is extended to my sister, Mrs. A. Bannick, for typing this thesis.

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CHAPTER I

THE PROBLEM

One of the first to suggest that reading disability may be caused by an inability to discriminate the speech sounds of words was Monroe in 1932.[1] Today most educators agree that the ability to discriminate among speech sounds is a basic factor that affects reading readiness and achievement.

Despite the general consensus that auditory discrimination is important, little research is available concerning the relationship between auditory discrimination and achievement in reading. Bond, in 1935, stated that the auditory characteristics of poor readers had been minimized by past investigators of reading disability. He found only four references to auditory characteristics and reading among 500 publications.[2] By 1948, a comprehensive survey of the literature by Inglis revealed that hearing in relation to reading had seldom been the subject of experimental study.[3] Wheeler and Wheeler, in 1954, stated that auditory discrimination as a factor in reading had been a topic for much speculation but limited research.[4] Finally, in 1966, after a

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[1]M. Monroe, Children Who Cannot Read (Chicago: University of Chicago, 1932), p. 93.

[2]G. L. Bond, The Auditory and Speech Characteristics of Poor Readers (New York: Teacher's College, Columbia University, 1935), p. 3.

[3]W. B. Inglis, "The Early Stages of Reading: A Review of Recent Investigations," Studies in Reading, Publications of the Scottish Council for Research in Education, Volume 1 (London: University of London Press Ltd., 1948), p. 26.

[4]L. R. Wheeler and V. D. Wheeler, "A Study of the Relationship of Auditory Discrimination to Silent Reading Abilities," Journal of Educational Research, 48:103, 1954.

few more studies had been undertaken, Dykstra still had to conclude that there was little research evidence available concerning the relationship between various auditory discrimination abilities and proficiency in reading at any grade level.[5]

In the studies which are available, auditory discrimination has been defined in several different ways and a great variety of measuring instruments has been employed. Correlations between auditory discrimination scores as measured by different instruments have been consistently low.[6]

There is little experimental data but even less theoretical justification for hypothesising a relationship between auditory discrimination and reading achievement, or for including training in auditory discrimination as a part of the grade one program. Only a limited number of studies and theoretical papers in psychology, linguistics, and neurology have been directly concerned with auditory discrimination. Psychologists have been concerned with perception and discrimination learning, but neither psychologists nor educators have attempted to draw implications from psychological studies for testing or teaching auditory discrimination in the classroom situation.

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[5]G. Dykstra, "Auditory Discrimination and Beginning Reading," Reading Research Quarterly, 1:7, Spring, 1966.

[6]Ibid., p. 43; M. C. Reynolds, "A Study of the Relationship between Auditory Characteristics and Specific Silent Reading Abilities," Journal of Educational Research, 46:44, 1953; R. L. Reid, "Auditory Aspects of Reading Readiness," (unpublished Master's thesis, University of Alberta, Edmonton, 1962), p. 69.

I. PURPOSE OF THE STUDY

The purpose of this study was to investigate the effect of taped training in auditory discrimination on the reading achievement and on the auditory discrimination of grade one subjects low in auditory discrimination. An examination of research concerning the nature of the reading process and discrimination learning was undertaken in an attempted justification for hypothesising a relationship between auditory discrimination and reading achievement, and for undertaking a training program in auditory discrimination. A careful examination was also made of the studies presently available which are directly concerned with the relationship between auditory discrimination and reading achievement to determine: which aspects of auditory discrimination are most closely related to reading achievement; which variables affect ability to make auditory discriminations; and the effectiveness of auditory discrimination programs which have been used in research studies. Finally, auditory discrimination test results were analysed to indicate the relative difficulty of particular speech sound types, and the influence of selected bias variables on the ability of subjects to discriminate these sound types at the grade one level.

II. HYPOTHESES

In order to investigate the effect of taped training in auditory discrimination on reading achievement and on auditory discrimination, the following null hypothesis was tested.

1. There will be no significant effects or interactions of treatments and
   (1) intelligence
   (2) mental age
   (3) sex
   (4) chronological age
   (5) socio-economic status
   (6) auditory acuity

on the following criteria scores:
   a. total auditory discrimination of speech sounds
   b. auditory discrimination of specific sound types
   c. oral reading
   d. silent reading
      i. word recognition
      ii. comprehension

In order to determine the relative difficulty of particular speech sound types, and the influence of certain bias variables on the ability of subjects to discriminate these sound types, the following null hypotheses were tested.

2. There will be no significant difference in ability to make auditory discriminations among the following types of sounds:
   a. sound contrasts
      i. stops
      ii. nasals
      iii. semivowel-lateral comparisons
      iv. fricatives
      v. affricate-fricative comparisons
      vi. fricative-stop comparisons
   b. voiced and voiceless sounds
   c. sounds in initial, medial and final position
   d. like and unlike pairs

3. There will be no significant relationship between ability to make auditory discriminations and
   a. sex
   b. chronological age
   c. socio-economic status

III. DEFINITIONS

For the purpose of this investigation, the following definitions were used:

Auditory Discrimination is the ability to hear similarities and differences of speech sounds in words.

Reading Achievement refers to the oral and silent reading performance of the student test sample as measured by the Gray Oral Reading Tests, Forms A and B, and the Lee-Clark Reading Test, First Reader, Forms A and B.

Auditory Discrimination Training refers to word pair exercises presented at listening centers designed to increase the ability of students low in auditory discrimination to hear similarities and differences of speech sounds in words.

IV. ORGANIZATION OF THE EXPERIMENTAL STUDY

Subjects for the experimental study were grade one pupils from four classrooms in two schools selected by officials of the Edmonton Public School Board. A sample was selected on the basis of results obtained from the administration of the Fast-Cosens Auditory Discrimination Test to 117 children in these four classrooms during early May. Scores on the discrimination test were used to rank the pupils on discrimination ability. The seventy-two children who were below the 60th percentile on this ranking were given an individual audiometer test, and the twelve subjects low on this test were eliminated from the study. The sixty children who passed the audiometer test were randomly assigned to the control or experimental groups. This resulted in thirty subjects per group. Both groups received intelligence, oral reading, and silent reading tests.

The experimental study involved a pretest-treatment-posttest comparison of subjects given training in auditory discrimination with subjects not given training. The treatment consisted of daily lessons for four school weeks from the middle of May to the middle of June. During these daily sessions, the experimental group received taped training in auditory discrimination, and the control group listened to a recorded story while they followed in their books. Lessons were presented at listening centers and were approximately ten minutes long.

Posttests were given during the week following the end of the treatment. All tests were given by, or under the supervision of the experimenter.

All data were recorded and punched on IBM cards. The main effects and interactions of treatments and the independent variables--sex, intelligence, mental age, chronological age, socio-econmonic status,and auditory acuity--were determined using multiple linear regression models. The relative difficulty of particular speech sound types, and the influence of certain bias variables on the ability of subjects to discriminate these sound types, was determined by t-tests. Processing was carried out by the Computing Center at the University of Alberta, Edmonton. The results of the statistical treatment were analysed by the investigator.

V. LIMITATIONS OF THE STUDY

The following limitations of the study were recognized:

1. Since the study was conducted near the end of the grade one year with posttests given during the last two weeks of June, there was

no opportunity to retest after a longer interval of time to determine the permanence of the effects of auditory training on reading achievement or auditory discrimination.

2. Four weeks was a relatively short training period to adequately assess the effects of auditory training on students low in auditory discrimination.

3. No attempt was made to estimate or take into account the effect of previous auditory discrimination and phonic training in classrooms on pretest or posttest scores of reading achievement and auditory discrimination.

VI. NEED FOR THE STUDY

As indicated previously, there has been relatively little research assessing the relationship between auditory discrimination and reading achievement. The major proportion of the research which is presently available tends to be correlational in nature. Since no definite conclusions can be drawn from this research, Dykstra feels that experimental studies are now needed.[7] The present study is an attempt to provide experimental evidence concerning the relationship between auditory discrimination and reading achievement at the grade one level. Grade one was chosen since auditory discrimination appears to be more important for reading achievement during beginning reading and tends to become less important in subsequent grades.[8]

The scarcity of experimental studies was criticized by Wheeler

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[7]Dykstra, op. cit., p. 33.

[8]Wheeler and Wheeler, op. cit., p. 111.

and Wheeler because they felt that teachers have a limited means for determining the best teaching techniques to use.[9] The present study attempted to indicate whether or not taped instruction presented at listening centers during the latter part of the grade one year was of benefit to students weak in auditory discrimination. An attempt was also made to ascertain which types of students gained most from such training.

Few tests of auditory discrimination are presently available, and even fewer are regularily administered to grade one pupils. Perhaps the test developed in this study will prove to be a valuable aid to teachers by pin pointing trouble spots in the auditory discrimination of grade one children. It may also be a useful clinical instrument.

VII. SUMMARY

There is relatively little research presently available concerning the relationship between auditory discrimination and reading achievement. The present experimental study was an attempt to investigate the effect of taped training in auditory discrimination on the reading achievement and the auditory discrimination of grade one pupils low in auditory discrimination. Auditory discrimination was defined as the ability to hear similarities and differences of speech sounds in words. The test population of 117 subjects was selected by officials of the Edmonton Public School Board. From this a sample of sixty subjects was selected on the basis of auditory

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[9]Wheeler and Wheeler, op. cit., p. 103.

discrimination scores and auditory acuity. The study involved a pretest-treatment-posttest comparison of an experimental group given training in auditory discrimination with a control group. Limitations involving the length and time of year of the training period, and the lack of control for previous auditory discrimination training were recognized. The study was needed to provide experimental evidence concerning some aspects of the relationship between auditory discrimination and reading achievement. An instrument for diagnosing strengths and weaknesses in auditory discrimination was also developed.

CHAPTER II

THE BACKGROUND OF THE STUDY

In order to understand more about the relationship between auditory discrimination and reading achievement, a knowledge of what reading involves was necessary. Only when such a knowledge was obtained could insights into the nature of the relationship between auditory discrimination and reading achievement be made.

Since the present study involved a training program to improve auditory discrimination, an understanding of how audition develops was desirable to determine first, whether or not training could result in improved auditory discrimination; and second, to suggest whether the close of the grade one year was an appropriate time for such training.

The actual planning of a training program was aided by knowledge concerning the features of sounds which make them discriminable, and the type of learning situation which enhances discrimination learning.

Chapter II will attempt to provide a justification for hypothesising first, that there is a relationship between auditory discrimination and reading achievement; and second, that auditory discrimination can be improved through a training program. Some suggestions concerning the attributes of a suitable training program will also be given.

I. AUDITORY DISCRIMINATION AND READING

Any discussion involving the relationship between auditory

discrimination and reading achievement must be based on an understanding of what reading involves. This section will attempt to arrive at a definition of reading by drawing on the work of prominent writers in the field of reading. It will then proceed to indicate the importance of auditory discrimination to reading achievement.

What is Reading?

Few textbook writers have attempted to define reading before going into practical discussions of materials and methods. Typical of the definitions which have been given is that of Russell who stated that reading involves simultaneously: sensation of light rays on the retina of the eye reaching the brain; perception of separate words and phrases resulting in recognition; comprehension beyond recognition of the meaning intended by the author; and finally, utilization involving the use of what one reads.[1]

Some writers, however, believe that a definition of reading must be more inclusive. They feel that a very broad concept is necessary to portray the many facets of reading. One broad base mentioned by Goodman and by Smith and Dechant is reading as communication.[2] They feel that the term communication indicates the importance of comprehension or shared meaning in reading.

Communication has been defined as a process involving

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[1]D. H. Russell, Children Learn to Read (Boston: Ginn and Company, 1949), pp. 74-82.

[2]H. P. Smith and E. V. Dechant, Psychology in Teaching Reading (New Jersey: Prentice-Hall, Inc., 1961), p. 21; K. S. Goodman, "A Communicative Theory of the Reading Curriculum," Elementary English, 40:291, March, 1963.

> a complex of events operating in several dimensions of space and time, and always involving the attitudes, the knowledge, the communication skills of more than one person and the social and cultural context in which he is located.[3]

There have been several models advanced to describe the communication process. A simple, yet inclusive model is the S-M-C-R model depicted below.[4] This model must be extended greatly to

S		M	C		R
SOURCE	encode	MESSAGE	CHANNEL	decode	RECEIVER

provide an acceptable description of reading, but the basic components of reading and communication are probably identical. Each component will be considered as a part of reading by citing and commenting on the work of prominent writers in the reading field.

Source. Jenkinson has shown concern for the writers' cognitive processes but too little attention from other authors has been given to the source of reading materials.[5] It is probable that the author's communication skills, attitudes, knowledge, and socio-economic environment also affect each of the other aspects in the reading process.

Encoding and the Nature of the Message. Encoding and the message have similarily been given minimal attention by most writers.

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[3]J. Ball, "Process: The Conceptual Basis for Communication Study," Research, Principles, and Practices in Visual Communication, J. Ball, editor (Washington, D. C.: National Education Association, 1960), p. 1.

[4]E. P. Bettinghaus, "The S-M-C-R Model of Communication," Research, Principles, and Practices in Visual Communication, J. Ball, editor (Washington, D. C.: National Education Association, 1960), p. 30.

[5]Statement by M. Jenkinson at a Graduate Seminar, Department of Elementary Education, University of Alberta, Edmonton, March 16, 1967.

Goodman is one exception. He pointed out that each written message is coded twice. An idea is encoded into oral language and then this is recoded into written language. When the child reads, he must first recode a message into oral language and then decode it to arrive at the author's ideas.[6] Goodman felt that the message itself, contains three types of information. The first is grapho-phonemic information which is defined as the relationships between spelling patterns of written language and sound patterns of oral language. The second is syntactic information which includes sentence patterns and structure signals. Finally, Goodman included semantic information which is a system of meanings and depends highly on the reader.[7]

Goodman's work clearly points out that communication of meaning is the purpose of all written messages. His work would lead away from undue emphases in reading programs on oral reading, coding, or grammar.

Channel. Some writers, such as Buswell, have viewed reading basically as visual perception.[8] Although Buswell probably over-emphasized the visual component of reading, it is well to remember that the auditory and visual aspects of reading cannot be clearly divorced since reading involves the association of aural symbols with visual

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[6] K. S. Goodman, "A Psycholinguistic View of Reading Comprehension," New Frontiers in College-Adult Reading, Fifteenth Yearbook of the National Reading Conference (Milwaukee: The National Reading Conference, Inc., 1966), p. 188.

[7] Ibid., pp. 192-193.

[8] G. T. Buswell, "The Process of Reading," Reading Teacher, 13:114, December, 1959.

symbols. Recent emphasis on multisensory approaches to reading instruction also suggests that the tactile channel is important to reading success for some children.[9] The visual, auditory, and tactile channels must all be considered in a comprehensive description of reading.

Decoding. Decoding has been considered by many writers in the field of reading. Gray's Model, however, is probably one of the most well known and widely accepted descriptions of the steps and skills involved in decoding.

Gray hypothesized that the first step in reading involved the reader focusing his attention to the printed page with his mind intent on meaning. Impressions received on the retina arouse nervous impulses which are transmitted over nerve channels to visual centers of the brain. Words may be recognized instantly or if they are not, a good reader applies word attack skills. As meaning associations are aroused and fused into a sequence of ideas, the reader reacts to the ideas to determine their value. He uses all he knows to reach valid conclusions which are reinforced or rejected by emotional responses. Finally, new ideas are fused with previous experiences to correct wrong concepts and give new insights.[10]

Gray realized that the steps of reading in his model are closely

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[9] J. M. Wepman, "The Perceptual Basis for Learning," Meeting Individual Differences in Reading, Supplementary Educational Monographs, Number 94 (Chicago: University of Chicago Press, December, 1964), pp. 24-33.

[10] W. S. Gray, "The Major Aspects of Reading," Sequential Development of Reading Abilities, Supplementary Educational Monographs, Number 90 (Chicago: University of Chicago Press, 1960), pp. 9-14.

interrelated and form a unit. This breakdown of reading skills and understandings was made to provide a means of discussing the complex process of reading. His realization that reading is not complete until the reader has reacted to and evaluated the ideas secured, and fused these ideas with previous experiences is of vital importance to a comprehensive understanding of reading.

Receiver. The receiver element of reading has been considered with several different emphases. Thorndike and Guilford have emphasized the thinking skills involved in reading.[11] Holmes and Singer, in their Substrata-Factor Theory of Reading, considered the wide variety of abilities and subabilities which enter into the reading act. They indicated that reading is a composite of speed and power.[12]

The importance of language development to reading has been emphasized by Ruddell.[13] Dechant was concerned with differences of readers in experiential background, intellectual development, physical development, socio-emotional development, and motivational readiness which can affect reading.[14]

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[11] E. L. Thorndike, "Reading as Reasoning: A Study of Mistakes in Paragraph Reading," Journal of Educational Psychology, 8:323-332, June, 1917; J. P. Guilford. "Frontiers of Thinking that Teachers Should Know About," Reading Teacher, 13:178, 1960.

[12] J. A. Holmes and H. Singer, Speed and Power of Reading in High School (Washington, D. C.: U. S. Government Printing Office, 1966), pp. 3-9.

[13] R. B. Ruddell, "Children's Language Development: Research and Implications," Claremont Reading Conference, Twenty-Ninth Yearbook (Claremont, California, 1965), p. 124.

[14] E. V. Dechant, Improving the Teaching of Reading (New Jersey: Prentice-Hall, Inc., 1964), pp. 10-86.

Reader characteristics must be considered to fully understand the impact of the other components of reading on the reader.

A Tentative Model of Reading. A combination of all the information given in this section resulted in the development of the tentative definition of reading depicted in Figure 1. This tentative definition suggests that there is a linear relationship among the elements and that each of the aspects in communication is a separate entity. Such a conception of reading would not be accurate. There is interaction and feedback all through the communication system although authors may not receive as much feedback as would be desirable. Reading can also occur on different levels. Messages can be encoded at varying levels of difficulty in sentence structure, vocabulary, and conceptualization. Reading may not go beyond the word recognition stage of decoding for some readers. For others, reaction to the ideas presented would culminate the reading activity.

Where does Auditory Discrimination fit into Reading?

Auditory discrimination appears to be related to most of the components in the tentative model of reading. Many of the variables listed as reader characteristics influence ability to make auditory discriminations. The extent to which these variables influence auditory discrimination will be discussed in Chapter III. The fact that auditory discriminations are made on the basis of information received through the hearing channel is obvious. The importance of auditory discrimination in decoding has been the emphasis of most writers. There has been considerable controversy, however, concerning

S	encoding	M	C	decoding	R
SOURCE		MESSAGE	CHANNEL		RECEIVER
AUTHOR					READER
Communication Skills	idea	Elements	v i s i o n	Sensation . . .	Cognitive Skills (reading-thinking skills)
Cognitive Processes thematic explanatory productive	e n c o d e	grapho-phonemic syntactic semantic	*	sight vocabulary Perception (recoding) word attack . . .	Intellectual Abilities
					Language Skills
Attitudes	speech		h e a r i n g	Comprehension (decoding) . . .	Physical Attributes
Knowledge	r e c o d e				Affective Aspects
Socio-Cultural Environment				Reaction . . .	Socio-Cultural Context
			*		Knowledge and Past Experience
	symbolic (written)		t o u c h	Fusing New Ideas with Old	

FIGURE 1

A TENTATIVE MODEL OF READING

which stages of decoding are affected by auditory discrimination, and whether an adequate development of auditory discrimination ability is necessary to distinguish only the grapho-phonemic elements of the message or the semantic and syntactic elements as well.

Auditory discrimination has been defined for this study as the ability to hear similarities and differences of speech sounds in words. A wide variety of definitions for auditory discrimination has been used by writers in the field of reading. Hence, when such writers consider the importance of auditory discrimination for reading, auditory discrimination may mean something entirely different than it does in this study. Still, the majority of writers agree that what they call auditory discrimination is important at the word perception stage of decoding especially during beginning reading. Betts stated that the ability to discriminate among the sounds of words is a prerequisite to the development of word perception.[15]

Harris felt that children must be able to hear sounds in words and to distinguish between sounds to make sound symbol--letter symbol associations.[16] Spache felt that auditory discrimination is essential for the effective use of such associations in word attack.[17] Wepman called auditory discrimination the "necessary ability which must

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[15] E. A. Betts, Foundations of Reading Instruction (New York: American Book Company, 1957), p. 331.

[16] A. J. Harris, Effective Teaching of Reading (New York: David McKay Company, Inc., 1962), p. 194.

[17] G. D. Spache, Reading in the Elementary School (Boston: Allyn and Bacon, Inc., 1964), pp. 164-165.

develop sufficiently for a child to produce accurate phonics for reading".[18] Schonell noted the following manifestations of a lowered power of auditory discrimination: inability to synthesize correctly the auditory elements of words; distortions in spelling; and a weakness in associating sounds with their correct visual symbols.[19]

Vernon viewed the role of auditory discrimination a little more broadly when she suggested that inadequate auditory discrimination may interfere with the development of an adequate knowledge of words and meanings for comprehension.[20]

Theories which attempt to outline the steps involved in perception have implications for the problem of whether auditory discrimination is important only for word recognition, or whether its influence on reading is much broader. Dember considered perception as a series of tasks. His simplest perceptual task was detection. It required the individual to indicate that a predefined stimulus event had occurred. This task blended into discrimination when the individual indicated there was a difference between two stimuli on some attribute. A much higher level of difficulty was reached when the individual indicated that he recognized the stimulus.[21] Dember's theory would tend to support the view that auditory discrimination

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[18] J. M. Wepman, "The Interrelationships of Hearing, Speech and Reading," Reading Teacher, 14:246, March, 1961.

[19] F. J. Schonell, Backwardness in the Basic Subjects (Toronto: Clarke, Irwin & Company Limited, 1942), p. 175.

[20] M. D. Vernon, Backwardness in Reading (Cambridge: University Press, 1957), p. 31.

[21] W. N. Dember, The Psychology of Perception (New York: Henry Holt and Company, 1960), pp. 25 & 26.

underlies word perception.

Hardy confined his discussion to the auditory realm and claimed that auditory mechanisms perform three basic functions: sensitivity, discrimination, and recognition. Directly related to these functions are processing, patterning, and retention.

> Processing means the ability to perceive rapidly successive bits of information: pattern-making means the capacity to relate this information in terms of significance to past and present behavior.[22]

Processing and patterning are dependent on the nature and extent of acoustic information coming through the system. Hence, Hardy considered discrimination important for many cognitive functions other than recognition.

Wepman postulated that audition develops on three levels with a sequence in the acquisition of the three levels. The first to develop is acuity. This involves the collection of sounds and transmission of the sounds to the nervous system by the ear. Second is understanding, the ability of the nervous system to interpret meaning from the aural patterns transmitted to it. Finally, discrimination and retention develop.[23] Wepman realized that infants are able to react to gross differences in sounds. He considered auditory discrimination as the ability to make fine distinctions among speech sounds.

Hardy felt that discrimination was necessary for recognition and other higher levels of understanding. Wepman believed the development

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[22] W. G. Hardy, "Dyslexia in Relation to Diagnostic Methodology in Hearing and Speech Disorders," Reading Disability: Progress and Research Needs in Dyslexia, J. Money, editor (Baltimore: The John Hopkins Press, 1962), p. 173.

[23] J. M. Wepman, "Auditory Discrimination, Speech and Reading," Reading Teacher, 13:327, March, 1960.

of discrimination followed the development of understanding. If both views are accurate, children may be hampered in learning word meanings by the relatively late development of ability to make fine auditory discriminations. At any rate, the ability to make gross discriminations and probably fine discriminations of aural stimuli appears to be related to comprehension to some extent.

Evidence of a more statistical nature is available from a limited amount of research concerned with the relationship between auditory discrimination and reading achievement. Wheeler and Wheeler, with a composite battery of auditory discrimination tests, measured the ability of upper elementary grade children to discriminate sounds and found significant correlations between composite auditory discrimination scores and both reading vocabulary and comprehension at the .01 level of confidence.[24] Dykstra, with a sample of grade one pupils, also found that several auditory discrimination measures were significantly related to both word recognition and paragraph reading.[25]

Reid tested three aspects of reading achievement and auditory discrimination at the beginning of the grade one year and again at the end. The results of an auditory discrimination test given in October were significantly related to all three aspects of reading achievement with correlation coefficients between .42 and .45. At the end of the year, auditory discrimination scores were more highly related with

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[24] L. R. Wheeler and V. D. Wheeler, "A Study of the Relationship of Auditory Discrimination to Silent Reading Abilities," Journal of Educational Research, 48:107-108, 1954.

[25] G. Dykstra, "Auditory Discrimination and Beginning Reading," Reading Research Quarterly, 1:23, Spring, 1966.

sentence and paragraph reading (r = .27 & .30) than with word recognition (r = .21) although all three were significantly related to auditory discrimination.[26]

Both theoretical and experimental evidence would tend to support the view that auditory discrimination is important for both word recognition and comprehension.

Another link between auditory discrimination and reading may be through the relationship both have to language development. The relationship between reading and language was considered briefly in the discussion of reading. Several writers have also postulated a close relationship between auditory discrimination and speech development. Bruns found that a group of children aged seven to sixteen who possessed articulatory defects scored significantly lower on an auditory discrimination test than a group of children with normal speech.[27] Christine and Christine also found the relationship between auditory discrimination and articulatory defects to be significant at the .01 level of confidence with a group of children from grades one, two, and three.[28]

The relationship between language and auditory discrimination appears to be of a complex nature. Deutsch contends that "it is only

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[26] R. L. Reid, "Auditory Aspects of Reading Readiness," (unpublished Master's thesis, University of Alberta, Edmonton, 1962), p. 69.

[27] J. M. Bruns, "An Experimental Study of Auditory Discrimination Ability of Children with Articulation Defects," Exceptional Children, 23:265, March, 1957.

[28] D. Christine and D. Christine, "The Relationship of Auditory Discrimination to Articulatory Defects and Reading Retardation," Elementary School Journal, 65:99, 1964.

through experience which involves consistent exposure to particular auditory stimuli that a child comes to discriminate sounds and to recognize words".[29] Olmstead, on the other hand, hypothesized that learning the phonology of a language is a function of the ease of perception of sounds. He predicted that the more discriminable sounds are learned earlier than the less discriminable ones.[30]

It is probable that auditory discrimination both affects and is affected by language development. Since reading is also related to the language development of the reader, auditory discrimination may affect reading indirectly through its importance to language development, and directly through its relationship with both word recognition and comprehension.

Summary

Reading is more complex and inclusive than most writers have indicated. A tentative definition was developed around a model of communication drawing on the work of many prominent writers in the field of reading. Most writers feel that auditory discrimination is very important for word recognition. It has also been suggested, however, that auditory discrimination may affect comprehension to some extent. Evidence, both theoretical and experimental, supports the contention that auditory discrimination may be related to both word recognition and comprehension.

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[29] C. P. Deutsch, "Auditory Discrimination and Learning Social Factors," Merrill-Palmer Quarterly of Behavior and Development, 10:278, July, 1964.

[30] D. L. Olmstead, "A Theory of the Child's Learning of Phonology," Language, 42:531, 1966.

II. TRAINING AUDITORY DISCRIMINATION

This section will attempt to outline the sequential development of audition to determine whether or not a training program could be expected to improve auditory discrimination. A description will also be given of the features which make sounds discriminable, and the type of learning situation which fosters discrimination learning to assist the planning of a training program.

Development of Auditory Perception

Kidd and Kidd noted from their survey of the literature concerned with the development of auditory perception that this topic has largely been ignored by researchers.[31] A few studies, however, have attempted to determine when a child can begin to receive auditory stimulation. Many indicate that hearing begins in the prenatal stage of development. Sontag and Wallace noted in their study that seven human fetuses responded to a sound frequency of 120 c.p.s. by movements of the fetal muscles.[32] Bernard recorded a change in the fetal heart beat of four subjects to a range of pure tones.[33]

Although hearing apparently occurs during the prenatal period, there is considerable controversy whether or not hearing is functional

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[31] A. H. Kidd and R. K. Kidd, "The Development of Auditory Perception in Children," Perceptual Development in Children, A. H. Kidd and J. L. Rivoire, editors (New York: International Universities Press, Inc., 1966), p. 113.

[32] L. W. Sontag and R. F. Wallace, "The Movement Response of the Human Fetus to Sound Stimuli," Child Development, 6:258, December, 1935.

[33] J. Bernard, "Human Fetal Reactivity to Tonal Stimulation," The American Psychologist, 1:256, July, 1946.

at birth. Bryan found that the evidences of hearing did not usually come in the first ten days, but were occasionally found from the third to the seventh day.[34] Opposite results were obtained by Froeschels and Beebe who investigated the hearing of thirty-three infants between one-half and nine days old and recorded a variety of reactions to different sounds. They concluded that hearing is present in the majority of newborn infants.[35]

Most studies with prenatal and newborn infants have used the startle reaction as an indication of hearing. Mykleburst feels it is important to separate startle or involuntary reactions from listening and voluntary behavior. He contends that listening behavior must be acquired and is dependent on learning and maturation. Although the auditory mechanism is fully developed at birth, the child does not attain the ability to make fine auditory discriminations or other mature forms of auditory behavior until much later. Hence, Mykleburst holds that the hearing mechanism does not mature, but the ability to listen does.[36]

Studies have found both training and maturation influential in improving ability to make auditory discriminations. Jeffrey trained three groups of kindergarten subjects on a task of differentiating between two tones. He was able to bring about a significant improvement

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[34] E. S. Bryan, "Variations in the Responses of Infants During First Ten Days of Post Natal Life," Child Development, 1:76, March, 1930.

[35] E. Froeschels and H. Beebe, "Testing the Hearing of Newborn Infants," Archives of Otolaryngology, 44:713, 1946.

[36] H. R. Mykleburst, The Psychology of Deafness (New York: Grune & Stratton, 1960), pp. 18-19.

in their performance on the task.[37] Deutsch suggested that instruction should be given early since many children enter grade one with poor auditory discrimination abilities organized. She postulated that there may be optimal times for training in auditory discrimination.[38]

The influence of maturation on auditory perception was evident in a study by Williams who found that auditory acuity increased from age three to age seven.[39] Wepman noted that the ability to make auditory discriminations frequently matured as late as the child's eighth year. He observed that children who received and those who did not receive speech therapy corrected their speech equally rapidly. He attributed this to the acquisition of the ability to make auditory discriminations. Wepman emphasized the maturational aspects of auditory discrimination rather than training.[40]

Most writers agree that both training and maturation are important factors in the development of auditory discrimination. Some writers have also suggested that genetic factors may be important. Monroe advanced the theory that lack of auditory discrimination might be a special innate defect like color blindness.[41] Schonell also suggested that the weakness was an inborn one and that it was always

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[37] W. E. Jeffrey, "Variables in Early Discrimination Learning: II. Mode of Response and Stimulation Differences in the Discrimination of Tonal Frequencies," Child Development, 29:537, December, 1958.

[38] Deutsch, op. cit., p. 282.

[39] H. M. Williams, "An Audiometric Test for Young Children," Child Development, 2:241, December, 1931.

[40] Wepman, op. cit., p. 328.

[41] M. Monroe, Children Who Cannot Read (Chicago: University of Chicago Press, 1932), p. 95.

present. He felt, however, that a continuous and careful training program could reduce the effects of poor auditory discrimination on reading and speech.[42]

Few definite conclusions can be drawn from research on the development of auditory perception, but it is safe to say that audition is influenced by training, inheritance, and maturation. The exact maturational sequence in auditory discrimination and the time at which the maximum capacity to develop auditory discrimination is reached are not known.

Since training influenced auditory discrimination in some studies, however, it seemed feasible to attempt the major purpose of the present study which was to discover the extent to which training could influence auditory discrimination near the end of the grade one year.

Features by Which Sounds are Discriminated

Discriminability of speech sounds has been partially investigated by linguists. Francis has noted, however, that linguists are generally more concerned with the production of sounds than with their transmission or reception.[43] One of the few studies concerned with reception of sounds was conducted by Miller and Nicely.

Miller and Nicely attempted to determine which features of phonemes were used as cues for discrimination. They asked subjects to record their discriminations of syllables under varying conditions of

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[42]Schonell, *op. cit.*, p. 175.

[43]N. W. Francis, *The Structure of American English* (New York: The Ronald Press Company, 1958), p. 57,

speech-to-noise ratios. Results were recorded on matrices of errors. These matrices revealed that the following features of phonemes were used as cues for discrimination: voicing, nasality, friction, duration, and place of articulation. Miller and Nicely found that some of these features were more discriminable than others. It was relatively easy for their subjects to discriminate between voiced and voiceless sounds, and between nasal and non-nasal sounds. It was much more difficult to discriminate between the fricatives and the non-fricatives; and between the sounds characterized by duration /s,š,z,ž/ and the rest of the consonants. It was most difficult to discriminate between the front /p,b,f,v,m,/, middle /t,d,θ,s,ð,z,n/, and back /k,g,š,ž/ consonants. Unfortunately, Miller and Nicely confined their analysis almost entirely to consonants in the initial position and did not consider vowels.[44]

Olmstead proceeded from Miller and Nicely's evidence to theorize that at any stage in language learning, there will be more errors based on place of articulation than on friction or duration, and more errors based on place, friction, or duration than on voicing or nasality.[45]

A different type of research with speech transmission and reception has been undertaken at the Haskin's laboratories. Workers have used synthetic speech in an attempt to isolate some of the acoustic cues which carry the basic linguistic information. Liberman divided consonants into three classes on the basis of their findings.

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[44]G. A. Miller and P. E. Nicely, "An Analysis of Perceptual Confusions among Some English Consonants," Psycholinguistics: A Book of Readings, S. Saporta, editor (New York: Holt, Rinehart and Winston, 1966), pp. 153-175.

[45]Olmstead, op. cit., p. 533.

The first class, constriction sounds (fricatives, affricates and stops), die away before vowel sounds. Variations of frequency, duration, nature of onset, intensity, and friction provide important clues for distinguishing these sounds from others. A second class of sounds are the nasals which are differentiated from other sounds by nasal resonation. The third class, voiced sounds, are affected by the articulatory movement that is made when going from the consonant to the vowel. There are for each consonant characteristic frequency positions or loci at which formant transitions begin. The transitions are movements of formants from the locus of a consonant to the frequency level of the next phone. The locus tends to move with the frequency of the following vowel. Cues such as transition duration and the presence or absence of a silent interval between the locus and start of transition can be used to distinguish stops and nasals from semivowels.[46]

A training program in auditory discrimination should recognize the progression in the child's ability to use cues for discriminating sounds. It should also provide a variety of vowels following each consonant so pupils can learn to make use of formant transitions as additional cues to discrimination.

Discrimination Learning

Psychologists have shown considerable interest in discrimination learning, but implications from their studies have generally not been drawn by educators for teaching auditory discrimination in the schools.

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[46]A. M. Liberman, "Some Results of Research on Speech Perception," Psycholinguistics: A Book of Readings, S. Saporta, editor (New York: Holt, Rinehart and Winston, 1966), pp. 142-153.

Theories of discrimination learning fall into two general groups. The continuity or stimulus response reinforcement theory was proposed by Hull and Spence.

Hull claimed that simple discrimination learning involved the power of responding differentially to stimuli. He felt that the primary process which gave rise to the discrimination of the stimulus complex was differential reinforcement.[47] Spence stated that discrimination learning "involves the strengthening of the excitatory tendency of a certain component of the stimulus complex...until it attains sufficient strength to determine the response".[48] If auditory discrimination was taught by this theory, the responsibility would rest on the teacher to reinforce appropriate responses.

The other principle theory of discrimination learning is the non-continuity theory which suggests that subjects try out hypotheses about the discrimination problem they are required to solve, testing one hypothesis and then another until they hit upon the correct solution. Krechevsky believed that animals actively compared stimuli and reacted differentially upon the basis of perceived relations between them.[49] If auditory discrimination was taught by this theory, the teacher would relegate considerable responsibility to the child.

Deese and Hulse feel that neither of the above theories provides

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[47]C. L. Hull, A Behavior System (New Haven: Yale University Press, 1952), pp. 94-95.

[48]K. W. Spence, "The Nature of Discrimination Learning in Animals," Psychological Review, 43:430, 1936.

[49]I. Krechevsky, "Hypotheses in Rats," Psychological Review, 38:532, 1932.

a completely satisfactory account of the process by which organisms learn to discriminate. Psychologists today are becoming interested in other types of problems concerning discrimination learning.[50]

One aspect of discrimination learning which is pertinent for teaching is the concept of acquired distinctiveness of cues. Liberman used this concept to explain his finding that listeners could discriminate sounds only to the extent that they could identify them as different phonemes. He postulated that to very young children, speech sounds cannot be discriminated. It is only with long experience with the language that discriminations become selectively sharpened through acquired distinctiveness.[51]

Stollnitz has emphasized the importance of the observing response in discrimination learning. He defined an observing response as "any response that results in exposure to a discriminative stimulus".[52] An organism must attend to a stimulus before it can produce a choice. If it does not attend, it does not have the information necessary to solve the problem. Mykleburst has indicated that hearing is largely a background sense since auditory stimulation is always present.[53] Hence, a deliberate effort is necessary to train children to attend to auditory stimulation.

Several studies have attempted to determine whether simultaneous

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[50] J. Deese and S. H. Hulse, The Psychology of Learning (New York: McGraw-Hill Book Company, 1967), p. 184.

[51] Liberman, op. cit., pp. 151-152.

[52] F. Stollnitz, "Spatial Variables, Observing Responses and Discrimination Learning Sets," Psychological Review, 72:247, 1965.

[53] Mykleburst, op. cit., p. 46.

or successive presentation of stimuli results in more efficient training of discrimination tasks. In simultaneous presentation, two stimuli are simultaneously presented on each trial. In successive presentation, stimuli are presented singly, one per trial.[54] Grice found that it was not necessary for animals to compare stimuli in order to learn a discrimination. He concluded that a differential response developed simply as a result of the build up of habit strength and inhibition to the specific stimulus.[55] Most experiments, however, have shown that the opportunity to compare stimuli simultaneously results in transfer to similar discriminatory tasks. Baker and Lawrence, for example, taught rats to discriminate between circles of different sizes. The simultaneous group found both the rewarded circle and the unrewarded circle side by side in a given trial. The successive group found just one of the circles present on any one trial. After both groups had been trained, they were presented with two circles of yet different sizes. The simultaneous group responded correctly 78 per cent of the time while the successive group performed at a chance level.[56]

Since experiments have found that simultaneous presentation leads to transfer of discrimination learning, training in auditory

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[54] E. R. Hilgard and G. H. Bower, Theories of Learning (New York: Appleton-Century-Crofts, 1966), p. 513.

[55] R. G. Grice, "Visual Discrimination Learning with Simultaneous and Successive Presentation of Stimuli," Journal of Comparative and Physiological Psychology, 42:371, 1949.

[56] R. A. Baker and D. H. Lawrence, "The Differential Effects of Simultaneous and Successive Stimuli Presentation on Transposition," Journal of Comparative and Physiological Psychology, 44:381, 1951.

discrimination should probably involve contrasts of speech sounds to allow students to compare stimuli. However, since the auditory mechanism cannot clearly distinguish two speech sound stimuli at exactly the same time, actual simultaneous presentation would not be possible.

Kendler and Kendler have considered a mediating response as an aid to discrimination learning. They claimed that an external cue sets off an implicit non-overt response which in turn, has its own cue properties that become attached to the final set of overt choice responses. The mediating response acts as a sort of generalized label linking the stimulus with the response.[57] This suggests that familiarity with sounds would lead to the formation of internal mediating responses to facilitate discrimination of the sounds.

A final concept of importance to teaching auditory discrimination is the concept of discrimination learning sets. It has been found by Harlow that as animals solve a number of successive discrimination problems of the same type, they show an orderly and gradual improvement in their ability to solve any given problem.[58] Hence, practice on discrimination tasks would probably be beneficial both through immediate improvement and through transfer to future discrimination problems.

III. SUMMARY

Before auditory discrimination could be considered as an aspect

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[57] H. H. Kendler and T. S. Kendler, "Vertical and Horizontal Processes in Problem Solving," Psychological Review, 69:6-7, 1962.

[58] H. F. Harlow, "The Formation of Learning Sets," Psychological Studies of Human Development, R. G. Kuhlen and G. G. Thompson, editors (New York: Appleton-Century-Crofts, 1963), p. 178.

of the reading process, the establishment of a clearcut conception of reading was necessary. A tentative definition of reading was developed around the S-M-C-R model of communication drawing on the work of several prominent theorists in the field of reading.

Most writers felt that auditory discrimination was definitely involved in the word recognition stage of decoding, and that it appeared to be specifically related to the use of phonics as a word attack skill. However, a few writers have allocated auditory discrimination a more general role in reading as one of the underlying factors affecting comprehension.

An inquiry into the developmental aspects of auditory perception indicated that training is influential in determining ability to make auditory discriminations, but that maturation and inheritance are also involved.

Linguists have outlined several features which are used to discriminate sounds. They suggest that there is a progression in the child's ability to discriminate particular features of speech sounds.

Considerable attention has been given to discrimination learning by psychologists. Neither of the two basic theories, the continuity or the non-continuity, was entirely satisfactory. Hence, it was not clear whether discrimination learning simply involves differential reinforcement and hence, is largely dependent on the teacher, whether it involves purposive, systematic behavior by the students, or whether it involves both. Several findings, however, had general implications for teaching auditory discrimination. Simultaneous presentation of stimuli appeared to be a more effective way of teaching discriminations than successive

presentation. The concept of the mediating response suggested that internal mediating responses develop from exposure to and familiarity with sounds. The concept of observing responses indicated the importance of attention. Finally, since learning sets develop from doing discrimination tasks, a carefully planned program in auditory discrimination would probably be valuable.

CHAPTER III

SURVEY OF RELATED RESEARCH

Several writers have noted that there is little research available concerning the relationship between auditory discrimination and achievement in reading. Although few studies are available, a careful examination of them was undertaken to determine which aspects of auditory discrimination are most closely related to reading achievement, which variables affect the ability to make auditory discriminations, and the effectiveness of auditory discrimination programs which have been used in research studies.

I. THE RELATIONSHIP OF SPECIFIC ASPECTS OF AUDITORY DISCRIMINATION TO READING

Experiments concerning the relationship between reading and auditory discrimination have measured nine different aspects of auditory discrimination. These will be carefully considered to determine which are most closely related to reading achievement.

Auditory Fusion

The first reported study which included an auditory blending or fusion test was that conducted by Monroe in 1932. Her test included fifteen words. Sounds were articulated at a rate of two per second. She found that a reading defect group was significantly different from a control group in ability to combine the isolated sounds into words.[1]

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[1]M. Monroe, Children Who Cannot Read (Chicago: University of Chicago Press, 1932), pp. 96-97.

In 1935, Bond gave three blending tests to grades two and three pupils. In the first, the examiner broke words into sounds which were given to pupils at one per second. The subjects were asked to tell what word was formed. The second blending test required the subjects to sound and fuse letters into sound configurations (nonsense words). In the third test, the subjects had to learn to associate sounds with non-letter symbols and to subsequently blend these sounds. All three of Bond's fusion tests were significantly related to reading.[2]

Gates (1939) computed correlations between reading scores and the blending ability of pupils as they progressed from grades one to four. Word sounds were articulated with a slight pause between them and subjects were required to mark a picture to indicate what word the sounds made. He found significant correlations between reading scores and auditory fusion only in classrooms where phonetic training was being given.[3]

Gates conducted a further study in 1947 with grade one pupils using the test he had used in 1939 and an additional blending test which required the pupils to translate letters to sounds and to blend these into nonsense words. The results of both tests were significantly related to reading achievement.[4]

Ewers made an extensive survey of the auditory characteristics

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[2] G. L. Bond, The Auditory and Speech Characteristics of Poor Readers (New York: Teacher's College, Columbia University, 1935), pp. 26-29.

[3] A. I. Gates, "An Experimental Evaluation of Reading Readiness Tests," Elementary School Journal, 39:499, 1939.

[4] A. I. Gates, "A Correlational Study of a Battery of Reading Diagnostic Tests," Journal of Educational Research, 40:443, 1947.

of high school students and included a letter blending test in the battery of auditory tests she used. Correlations between the results of this test and reading achievement were low but significant.[5]

Reynolds gave a test to grade four pupils in which sounds were presented at one second intervals and pupils attempted to blend the sounds into whole words. He found that oral blending ability was not significantly related to general reading achievement.[6]

Mulder and Curtin also used a fourth grade sample. They administered a test in which the phonetic elements of words were pronounced separately at one second intervals and pupils marked one of three pictures to indicate the word heard. The relationship between scores on this test and reading scores was significant at the .01 level.[7]

Chall and co-workers followed the progress of sixty-two negro children from grades one to four. They used the Roswell-Chall Auditory Blending Test in which the examiner sounded component parts of words at about one-half second intervals and asked the subjects to tell what they heard and write it in a blank. They found that blending ability was substantially related to reading.[8]

Dykstra administered an auditory blending test to grade one

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[5]D. Ewers, "Relations between Auditory Abilities and Reading Abilities: A Problem in Psychometrics," Journal of Experimental Education, 18:247, 1950.

[6]M. C. Reynolds, "A Study of the Relationship between Auditory Characteristics and Specific Silent Reading Abilities," Journal of Educational Research, 46:446, 1953.

[7]R. L. Mulder and J. T. Curtin, "Vocal Phonic Ability and Silent Reading Achievement: A First Report," Elementary School Journal, 56:123, 1955.

[8]J. Chall, F. Roswell and S. Blumenthal, "Auditory Blending Ability: A Factor in Success in Beginning Reading," Reading Teacher, 17:113-118, November, 1963.

subjects and found that the results yielded small but significant correlations with reading achievement.[9]

Although most investigators found a significant relationship between auditory discrimination and reading achievement, the correlations were generally low and a variety of testing methods were used (Table I). Hence, a test of auditory fusion was not considered in the present study.

Rhyming

Gates and Bond in 1936 gave the rhyming subtest of the Gates Reading Readiness Test to grade one pupils. They found that rhyming ability failed to discriminate between those who were good and poor in reading in grade one.[10]

Gates used the same test in two additional studies in 1939 and 1940. In the first study, he found that rhyming was related to reading achievement only in classes being given training in phonics.[11] In his second study, small but significant correlations between rhyming and reading achievement were found.[12]

Dykstra administered two tests of rhyming to grade one pupils. The first was the rhyming subtest from the Gates Reading Readiness Test

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[9]G. Dykstra, "Auditory Discrimination and Beginning Reading," Reading Research Quarterly, 1:23, Spring, 1966.

[10]A. I. Gates and G. L. Bond, "Reading Readiness: A Study of Factors Determining Success and Failure in Beginning Reading," Teachers College Record, 37:681, 1936.

[11]A. I. Gates, "An Experimental Evaluation of Reading Readiness Tests," p. 503.

[12]A. I. Gates, "A Further Evaluation of Reading Readiness Tests," Elementary School Journal, 40:591. 1940.

TABLE I

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN AUDITORY FUSION AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Monroe (1932)	<u>Monroe Reading Aptitude Tests</u>	Significant	Control age 6-9 Reading retardates age 8-5	Comparison of reading retardates with good readers
Bond (1935)	Examiner sounded letters, child gave word.	C.R.=5.2 Significant	Grades two and three	Matched pairs: Comparison of good and poor readers
	Child sounded and fused letters	C.R.=7.0 Significant		
	Child learned associations and fused them	C.R.=6.0 Significant		
Gates (1939)	Examiner sounded letters, child gave word	Significant in classes where phonetic training given	Grades one to four	Longitudinal: Predictive
Gates (1947)	Child sounded and fused letters of nonsense words	r=.71 Significant	Grade three	Correlational: Unselected population
	Examiner sounded letters, child gave word.	r=.54 Significant		

TABLE I (continued)

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN AUDITORY FUSION AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Ewers (1950)	Letter blending	silent r=.23 oral r=.19 Significant	High School	Correlational: Unselected population
Reynolds (1953)	Examiner sounded letters, child gave word.	Not Significant	Grade four	Correlational: Unselected population
Mulder and Curtin (1955)	Examiner sounded letters, child gave word.	r=.44 Significant	Grade four	Correlational: Unselected population
Reid (1962)	Auditory Fusion (Betts)	Not Significant	Grade one	Predictive
	Auditory Fusion (Neale)	r=.36 to .43 Significant		
Chall and others (1963)	<u>Roswell-Chall Auditory Blending Test</u>	r=.26 to .66 Significant	Grades one to four	Correlational: Unselected population
Dykstra (1968)	<u>Monroe Reading Aptitude Test</u>	r=238 to .243 Significant	Grade one	Predictive

and the second was the Murphy-Durrell Diagnostic Readiness subtest for rhyming ability. While both tests were significantly related to reading scores, correlations were not high.[13]

Results of rhyming tests have been either not significantly related to reading achievement, or related by low correlations (Table II). For this reason, a test of rhyming was not considered for the present study.

Pitch Discrimination

Kennedy gave the Seashore Pitch Discrimination Test to children aged ten, twelve, and fifteen. She found a significant relationship between silent reading ability and pitch discrimination.[14]

Reynolds also used the Seashore Pitch Discrimination Test with fourth grade pupils and found a significant relationship between this factor and general reading ability in some of the schools tested. However, when mental age was held constant, the relationship lost significance.[15]

Wheeler and Wheeler used the Seashore test with upper elementary subjects and found that there was a significant relationship between reading vocabulary and pitch discrimination in grades five and six, but not in grade four. Pitch discrimination was not related to reading comprehension at any of the grade levels.[16]

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[13] Dykstra, op. cit., p. 23.

[14] H. Kennedy, "A Study of Children's Hearing as it Relates to Reading," Journal of Experimental Education, 10:248-249, June, 1942.

[15] Reynolds, op. cit., pp. 444-445.

[16] Wheeler and Wheeler, op. cit., p. 105.

TABLE II

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN ABILITY TO DISCRIMINATE AUDITORY RHYMES AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Gates and Bond (1936)	Gates Reading Readiness Test	Not Significant	Grade one	Predictive
Gates (1939)	Gates Reading Readiness Test	Significant only in classes given phonetic training	Grades one to four	Longitudinal: Predictive
Gates (1940)	Gates Reading Readiness Test	r=.28 Significant	Grade one	Predictive
Dykstra (1966)	Gates Reading Readiness Test	r=.348 & .328 Significant	Grade one	Predictive
	Murphy-Durrell Diagnostic Readiness Test	r=.212 & .185 Significant		

Ewers measured four aspects of pitch discrimination: complex sounds, pure tones, tones of short impulse, and vocal sounds. Only pitch discrimination for tones of short impulse was significantly related to both silent and oral reading ability. However, on this test Ewers believed it was the time element rather than the pitch element which was important. She postulated that reacting discriminately to a very short stimulus was related to good reading.[17]

Pitch discrimination does not appear to be closely related to reading achievement since correlations between reading achievement and pitch discrimination were not significant in several of the studies cited (Table III). Hence, a test of pitch discrimination was not used in this study.

Discrimination and Orientation

Poling tested seventy-eight poor readers aged eight to thirteen on the discrimination and orientation subtest of the Monroe-Sherman Group Diagnostic Aptitude Test--Intermediate Form. This tests two aspects of auditory performance: the discrimination of minute differences of letter sounds within words; and the position of the chosen word in a list of four words pronounced. Poling found no significant difference between the means of pupils with high and those with low auditory discrimination on reading achievement.[18]

Bradshaw used the same test as Poling with children from adaptation classes aged ten to fifteen years. When the percentile

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[17]Ewers, op. cit., p. 246.

[18]D. L. Poling, "Auditory Deficiencies of Poor Readers," Clinical Studies in Reading II, Supplementary Educational Monographs, Number 77 (Chicago: University of Chicago Press, 1953), p. 110.

TABLE III

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN PITCH DISCRIMINATION AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Kennedy (1942)	Seashore Pitch Discrimination Test	Significant	Ages 10, 12 and 15	Disabled Readers
Ewers (1953)	Complex Sounds	silent r=.09 oral r=.10	High School	Correlational: Unselected population
	Pure Tones	r=.03 r=.20*		
	Tones of Short Impulse	r=.70* r=.26*		
	Vocal Sounds	r=.19* r=.13 *Significant		
Reynolds (1953)	Seashore Pitch Discrimination Test	Not significant when MA was held constant	Grade four	Correlational: Unselected population
Wheeler and Wheeler (1954)	Seashore Pitch Discrimination Test	Significant for vocabulary but not comprehension	Grades four to six	Correlational: Unselected population

was computed for the total pupil group, she found that the results for this auditory skill were slightly below the normal percentile range.[19]

Neither Bradshaw nor Poling found discrimination and orientation significantly related to reading achievement so testing in this aspect was not considered in the present study (Table IV).

Discrimination in Complex Patterns

This aspect of auditory discrimination was measured by the Complex Speech Sound Discrimination Test. An artificial word was presented correctly in a meaningful phrase twice. Then the phrase was read six times, once correctly, and five times with different errors. The subjects decided which was like the original. Larson and Feder gave this test to University freshmen and found that complex sound discrimination played only a small part in reading comprehension difficulties.[20]

Hall used this test with elementary pupils. She found that the results were not significantly related to reading achievement.[21]

Since ability to discriminate speech sounds in a complex pattern does not appear to be related to reading achievement, this type of test was not used in the present study (Table V).

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[19] E. Bradshaw, "Patterns of Perceptual Performance in Children Who are Severely Retarded in Reading," (unpublished Master's thesis, University of Alberta, Edmonton, 1963), p. 100.

[20] R. P. Larson and D. D. Feder, "Common and Differential Factors in Reading and Hearing Comprehension," Journal of Educational Psychology, 31:249, April, 1940.

[21] M. E. Hall, "Auditory Factors in Functional Articulatory Speech Defects," Journal of Experimental Education, 7:126, December, 1938.

TABLE IV

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN DISCRIMINATION AND ORIENTATION AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Poling (1953)	Monroe-Sherman Group Diagnostic Aptitude Tests	Not Significant	Ages 9 to 13	Comparison of clinical cases and normal readers
Bradshaw (1963)	Monroe-Sherman Group Diagnostic Aptitude Tests	Slight	Ages 10 to 15	Reading disability cases

TABLE V

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN DISCRIMINATION OF SOUNDS IN COMPLEX PATTERNS AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Hall (1938)	Complex Speech Sound Discrimination Test	Not Significant	University	Comparison of normal articulators and those with difficulties
Larson and Feder (1940)	Complex Speech Sound Discrimination Test	Not Significant	Grades two to six	Correlational: Unselected population

Auditory Rhythm

Bond used the Seashore Auditory Rhythm Test and arrived at a critical ratio of 2.4 for the difference between his good and poor readers. This difference was not significant.[22]

Ewers found small but significant correlations between oral and silent reading achievement and musical rhythm as measured by having subjects indicate whether musical phrases produced on a piano were in two, four, six, or eight time. She also used the Seashore test and found that its results were not significantly related to reading success.[23]

Vernon stated that the inability to blend speech sounds correctly to form words may be due in part to poor perception of temporal order and rhythm. She quoted a study by Stambak which found that children with reading disability, aged seven to fourteen, were much poorer than normal readers in copying temporal rhythms and repeating them over a period of time.[24]

Gould gave an auditory motor match test to grade one pupils in which the examiner tapped a pattern and the examinee was asked to copy it. This was the only rhythmic measure which showed consistent differences between the high and low readers.[25]

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[22]Bond, op. cit., pp. 33-34.

[23]Ewers, op. cit., p. 246.

[24]M. D. Vernon, Backwardness in Reading (Cambridge: University Press, 1957), p. 62.

[25]D. E. Gould, "An Investigation into the Relationship of Rhythmic Ability and Reading Achievement," (unpublished Master's thesis, University of Alberta, Edmonton, 1966), p. 104.

Although auditory rhythm has been found by some investigators to be significantly related to reading achievement, the results are inconsistent (Table VI). Hence, the present study did not consider a test of auditory rhythm as a possible measuring instrument.

Discrimination of Similar Sounds

Bond found that the ability of grades two and three pupils to read was significantly related to their ability to give words beginning and ending with particular sounds.[26] Gates also found significant correlations between silent reading achievement and ability to give words beginning with particular sounds at the grade three level.[27]

Ewers presented words in pictures and asked subjects to indicate the picture which contained a given sound in the initial, medial or final position. Results of Ewer's test were significantly related to both oral and silent reading achievment.[28]

Reid and Dykstra gave two subtests of the Murphy-Durrell Diagnostic Reading Readiness Test which measured ability to recognize similarities in beginning consonants and blends and in final consonants and rhymes. They used grade one subjects and both found low correlations between the results of this test and reading achievement.[29] Dykstra

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[26] Bond, *op. cit.*, pp. 33-34.

[27] Gates, "A Correlational Study of a Battery of Reading Diagnostic Tests," p. 443.

[28] Ewers, *op. cit.*, p. 247.

[29] R. L. Reid, "Auditory Aspects of Reading Readiness," (unpublished Master's thesis, University of Alberta, Edmonton, 1962), p. 79.

TABLE VI

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN ABILITY TO DISCRIMINATE AUDITORY RHYTHM AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Bond (1935)	Seashore Auditory Rhythm Test of Memory	C.R.=2.4 Not Significant	Grades two and three	Comparison of good and poor readers
Ewers (1950)	Musical Rhythm	silent oral r=.18 r=.19 Significant	High school	Correlational: Unselected population
	Motor Rhythm from Seashore Test of Musical Talent	r=.13 r=.00 Not Significant		
Stambak (1951) cited in Vernon		Significant	Ages 7 to 14	Comparison of reading disability cases and normal readers
Gould (1966)	Auditory Motor Match	t=4.27 Significant	Grade one	Correlational: Unselected population

administered the Harrison-Stroud Making Auditory Discriminations test in addition to the Murphy-Durrell. The results of the Harrison-Stroud test, which measured essentially the same ability as that measured by the Murphy-Durrell, were more highly related to reading achievement than those of the Murphy-Durrell.[30]

The ability to produce or recognize words beginning or ending with a particular sound was found to be consistently related to reading achievement (Table VII). Testing in this aspect was considered as one possibility in the present study.

Composite Auditory Discrimination Scores

Wheeler and Wheeler tested the ability of upper elementary pupils to discriminate sounds by a test with four parts: word pairs, sound element pairs, final blends, and sound elements within words. The correlations of both reading vocabulary and comprehension with auditory discrimination were positive and significant.[31]

Harrington gave an auditory discrimination test which measured ability to notice initial consonant sounds, rhyming at the end of words, final consonants, and combinations of initial and final consonants in words spoken by the examiner. Auditory discrimination as measured by this test was significantly related to reading achievement of pupils at the end of grade two.[32]

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[30] Dykstra, op. cit., p. 23.

[31] L. R. Wheeler and V. D. Wheeler, "A Study of the Relationship of Auditory Discrimination to Silent Reading Abilities," Journal of Educational Research, 48:105, 1954.

[32] Sister Mary James Harrington and D. Durrell, "Mental Maturity versus Perception Abilities in Primary Reading," Journal of Educational Psychology, 46:378, 1955.

TABLE VII

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN ABILITY TO DISCRIMINATE SIMILAR SOUNDS AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Bond (1935)	Subjects gave words beginning with a particular sound.	C.R.=5.7 Significant	Grades two and three	Comparison of good and poor readers
	Subjects gave words ending with a particular sound.	C.R.=4.2 Significant		
Gates (1947)	Same as Bond.	r=.65 r=.52 Significant	Grade Three	Correlational: Unselected population
Ewers (1950)	Subjects indicated which picture contained sound presented:	silent oral *Significant	High School	Correlational: Unselected population
	Initial position	r=.19* r=.31*		
	Medial position	r=.33* r=.36*		
	Final position	r=.30* r=.36*		
Reid (1962)	Murphy-Durrell Auditory Discrimination Test of Beginning and Ending Sounds	silent oral r=.22 r=.45* to .40*	Grade one	Predictive
Dykstra (1966)	Harrison-Stroud Making Auditory Discriminations	r=.423 & .432 Significant	Grade one	Predictive
	Murphy-Durrell Auditory Discrimination Test	r=.218 & .221 Significant		

Thompson made a longitudinal study of grade one pupils in which she administered three tests of auditory discrimination: the Wepman Auditory Discrimination Test; the Boston University Speech Sound Discrimination Picture Test; and the SRA Reading Analysis Aptitude, Form A. The composite score from these three tests were significantly related to reading achievement.[33]

The batteries of auditory discrimination tests used by the above investigators yielded significant relationships between reading achievement and auditory discrimination (Table VIII). Hence, the administration of a battery of auditory discrimination tests was considered as a possibility in the present study.

Ability to Hear Similarities and Differences in Speech Sounds in Words (Word Pairs Test)

In 1932 Monroe found that reading defect cases differed significantly from students in the control group on ability to discriminate sounds in twenty word pairs.[34] Bond also used a word pairs test and found that the differences between good and poor readers approached significance. The differences were more significant for a group taught by a phonetic method.[35]

Wolfe and Robinson both tested clinic cases with word pairs tests and concluded that poor auditory discrimination may be a cause of

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[33]B. B. Thompson, "The Relation of Auditory Discrimination and Intelligence Test Scores to Success in Primary Reading," (unpublished Dissertation, Indiana University, 1961), p. 87.

[34]Monroe, op. cit., p. 94.

[35]Bond, op. cit., p. 32.

TABLE VIII

SUMMARY OF STUDIES ON THE RELATIONSHIP OF COMPOSITE AUDITORY DISCRIMINATION SCORES AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Wheeler and Wheeler (1954)	I. Word pairs II. Sound pairs III. Rhymes IV. Sounds within words	Significant	Grades four, five and six	Correlational: Unselected population
Harrington (1955)	Ability to notice initial consonant sounds; rhyming; and finding consonants and combinations of consonants in words spoken by examiner	r=.54 Significant	Grade two	Correlational: Unselected population
Thompson (1961)	1. Wepman Auditory Discrimination Test 2. Boston University Speech Sound Discrimination Picture Test 3. SRA Reading Analysis Aptitude, Form A	t=6.6426 t=6.7448 Significant	Grades one and two	Longitudinal: Predictive

reading retardation.[36]

Gates found the correlation between a word pairs auditory discrimination test and silent reading ability at the third grade level to be significant but small.[37] Ewers included a word pairs test in the battery she administered to high school students and found that scores on this test were not significantly related to reading achievement.[38] Steinback gave readiness tests to over 300 first grade entrants and found that the ability to hear likenesses and differences in speech sounds was significantly related to reading achievement. Auditory discrimination was the most influential factor on learning to read that Steinback tested.[39] Reynolds used a fourth grade sample and found that when mental age was held constant, the results of a word pairs test were not significantly related to reading achievement.[40]

Several investigators have used the Wepman Auditory Discrimination Test. Deutsch tested pupils from grades one, three, and five. She found that scores on the Wepman test differentiated good from poor readers at the .001 level in all three grades.[41]

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[36] L. S. Wolfe, "Differential Factors in Specific Reading Disability II. Audition, Vision, Verbal Association, and Adjustment," Journal of Genetic Psychology, 58:70, 1941; H. M. Robinson, Why Pupils Fail in Reading (Chicago: University of Chicago Press, 1946), p. 231.

[37] Gates, "A Correlational Study of a Battery of Reading Diagnostic Tests," p. 443.

[38] Ewers, op. cit., p. 246.

[39] Sister Mary Nila Steinback, "Foundations of a Successful Reading Program," Education, 73:547, May, 1953.

[40] Reynolds, op. cit., pp. 444-445.

[41] C. P. Deutsch, "Auditory Discrimination and Learning Social Factors," Merrill-Palmer Quarterly of Behavior and Development, 10:285, July, 1964.

Christine and Christine gave the Wepman test to a control group, a group of reading retardates, and a group with articulatory defects in grades one, two, and three. They found that poor auditory dicrimination was significantly related to reading retardation.[42]

Wepman used his test with first and second graders. He found that children with poor discrimination scores on his forty word pairs were more likely to be poor readers than good or average readers.[43]

Finally, Reid gave the Wepman Auditory Discrimination Test to grade one entrants in October and again in May. The correlations with reading were significant on both administrations but higher on the October than the May testing.[44]

Each study which used the Wepman Auditory Discrimination Test found that its results were significantly related to reading achievement.

Two studies used the Rasmus-Travis Speech Sound Discrimination Test which tested discrimination of sounds in nonsense syllable pairs rather than words. Hall found that there was no significant relationship between scores on this type of test and reading achievement at either elementary or college level.[45] Templin tested grade four pupils and found that the correlations between reading scores and sound discrimination were not significant.[46]

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[42] D. Christine and D. Christine, "The Relationship of Auditory Discrimination to Articulatory Defects and Reading Retardation," Elementary School Journal, 65:99, 1964.

[43] J. M. Wepman, "Auditory Discrimination, Speech and Reading," Reading Teacher, 13:331, March, 1960.

[44] Reid, op. cit., p. 69.

[45] Hall, op. cit., p. 130.

[46] M. C. Templin, "Phonic Knowledge and its Relation to the Spelling and Reading Achievement of Fourth Grade Pupils," Journal of Educational Research, 47:453, 1954.

The majority of the studies using word pair tests found a significant relation between auditory discrimination and reading achievement. Studies using nonsense syllables, however, did not find positive correlations (Table IX). A word pairs test was considered as one possibility in the present study.

Summary

The studies cited indicate that there are three types of auditory discrimination scores related to reading achievment. These are: discrimination of similar sounds; composite auditory discrimination scores; and word pairs tests. The choice of one of these measures for this study will be made in Chaper IV. Attention will now be turned to the variables which affect ability to discriminate sounds.

II. VARIABLES WHICH AFFECT AUDITORY DISCRIMINATION

It has already been suggested that attention is an important variable in auditory discrimination and that pupils must be taught to attend to auditory stimulation. This variable was not systematically controlled in the present study, but was controlled to some extent by the random distribution of subjects to the control and experimental groups. Other variables which affect ability to make auditory discrimination will be discussed in this section.

Acuity

Betts believed that inadequate auditory discrimination could be caused by a hearing impairment.[47] Monroe and Robinson suggested from

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[47] E. A. Betts, Foundations of Reading Instruction (New York: American Book Company, 1957), p. 347.

TABLE IX

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN SCORES ON WORD PAIRS TESTS AND READING ACHIEVEMENT

a. Actual Words

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Monroe (1932)	Monroe Auditory Word Discrimination Test	Significant	Control age 6-9. Reading retardates age 8-5	Comparison of reading retardates and good readers
Bond (1935)		C.R.=2.0 Not significant	Grades two and three	Comparison of good and poor readers
Wolfe (1941)	Monroe Auditory Word Discrimination Test	Significant	Ages 8-11 to 9-11	Comparison of average and retarded readers
Robinson (1946)	Test organized by a speech pathologist	7/22 had trouble	Ages 6-9 to 15-3	Clinical cases
Gates (1947)		r=.30 Significant	Grade three	Correlational: Unselected population
Ewers (1950)	90 word pairs	r=.08 & .05 Not Significant	High school	Correlational: Unselected population
Reynolds (1953)		Not significant when MA held constant	Grade four	Correlational: Unselected population

TABLE IX (continued)

SUMMARY OF STUDIES ON THE RELATIONSHIP BETWEEN SCORES ON WORD PAIRS TESTS AND READING ACHIEVEMENT

Researcher	Test	Relationship to Reading Achievement	Age or Grade	Type of Study
Steinbach (1953)		Significant	Grade one	Predictive
Wepman (1960)	Wepman Auditory Discrimination Test	Significant	Grades one and two	Correlational: Unselected population
Reid (1962)	Wepman Auditory Discrimination Test	Significant	Grade one	Predictive
Christine and Christine (1964)	Wepman Auditory Discrimination Test	t=2.15 Significant	Grades one, two and three	Comparison between normal and retarded readers
Deutsch (1964)	Wepman Auditory Discrimination Test	Significant	Grades one, three and five	Correlational: Unselected population
		b. Nonsense Words		
Hall (1938)	Rasmus Travis Speech Sound Discrimination Test	Not Significant	Grades two to six	Comparison of normal articulators and those with articulation difficulties
Templin (1954)	Modification of Rasmus Travis Speech Sound Discrimination Test	r=.22 Not Significant	Grade four	Correlational: Unselected population

the results of their studies that poor auditory discrimination might be due to a defect in the auditory mechanism for some ranges of pitch and some sound qualities.[48] Both Hall and Reynolds, however, found that auditory discrimination was not related to acuity in their studies.[49]

Newby, a well known audiologist, pointed out two types of hearing disorders. The first, which involved a dysfunction of the outer or middle ear in the presence of a normal inner ear, was termed a conductive impairment of hearing. With such a loss, speech discrimination is relatively unimpaired. However, speech must be louder before the individual with a conduction loss can make discriminations. When a loss of hearing is due to pathology in the inner ear or along the nerve pathways from the inner ear to the brain stem, Newby referred to the loss as a perceptive impairment. With this type of impairment, there is generally some difficulty with speech discrimination. Typically hearing is better for lower than for higher frequencies.[50] Hence, inadequate auditory discrimination may be one of the symptoms of a hearing loss although a hearing loss may be present without any impairment of discrimination. Auditory acuity was included as a variable in this study by comparing the performance of subjects with adequate and borderline acuity on reading and auditory discrimination.

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[48]Robinson, _op_. _cit_., p. 18; Monroe, _op_. _cit_., p. 107.

[49]Hall, _op_. _cit_., p. 130; Reynolds, _op_. _cit_., p. 446.

[50]H. A. Newby, _Audiology_ (New York: Appleton-Century-Crofts, Inc., 1958), pp. 31-45.

Sex

Wepman suggested that auditory development is slower in boys than girls.[51]

From a comparison of auditory discrimination scores made by girls and boys near the beginning of grade one, Dykstra also concluded that girls are more mature than boys in this ability. He further noted that each of the auditory discrimination measures which demonstrated significant differences in favor of the girls, was also highly related to reading achievement.[52]

Reid obtained conflicting results in her study with grade one subjects. Girls made significantly higher scores than boys on the Wepman Auditory Discrimination Test in October. However, by the end of the first year, the boys were equally good if not better than the girls in auditory discrimination.[53]

No definite conclusions concerning the effect of sex on auditory discrimination can be drawn from the studies which are available. Since some studies have found a significantly positive relationship between auditory discrimination and sex, however, this variable was included in the present investigation.

Bilingualism

Betts suggested that bilingualism may be a possible causal

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[51] J. M. Wepman, "The Interrelationships of Hearing, Speech and Reading," Reading Teacher, 14:246, March, 1961.

[52] Dykstra, op. cit., pp. 21-22.

[53] Reid, op. cit., p. 70.

factor in inadequate auditory discrimination.[54] Harris felt that bilingualism might make it difficult for a child to perceive some sounds of spoken English correctly. A bilingual child might not hear sounds which are unique to English because he had never used them in his native language.[55]

Ewers found that bilingualism was highly correlated with syllable blending. She felt that knowing the pattern of sounds in a language was important for reading achievement.[56]

Although bilingualism appears to affect the ability to discriminate sounds, it could not be considered because only four children in the test population involved in this study were bilingual and the schools had no record of bilingualism among parents.

Intelligence

Intelligence has generally been considered as a quotient of mental age to chronological age by investigators of auditory discrimination.

An early study by Hall suggested that there was a relationship between IQ scores and those of auditory discrimination.[57] Wheeler and Wheeler found evidence to support Hall's suggestion in their study with upper elementary grade pupils.[58] Thompson also found that the

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[54] Betts, op. cit., p. 347.

[55] A. J. Harris, How to Increase Reading Ability (New York: David McKay Co. Inc., 1961), pp. 230-231.

[56] Ewers, op. cit., p. 248.

[57] Hall, op. cit., p. 130.

[58] Wheeler and Wheeler, op. cit., pp. 107-108.

intercorrelations between auditory discrimination and IQ scores were significant at the .01 level of confidence.[59]

Wepman, on the other hand, concluded from his study with grades one and two pupils that there was little if any relationship between the development of auditory discrimination and IQ scores.[60] Deutsch found that auditory discrimination scores correlated with verbal but not with non-verbal IQ scores.[61] Reid found a significant relationship between IQ scores and the scores of the Wepman Auditory Discrimination Test when administered in October. At the end of the year, however, correlations were greatly reduced. Reid noted that girls showed a higher relationship of IQ with auditory ability than boys.[62] Finally, Dykstra found the correlations between IQ and auditory discrimination measures moderate but significant.[63]

There appears to be a positive relationship between IQ and auditory discrimination scores but the magnitude of this relationship is unknown. IQ was considered as a possible bias variable in the present study.

Mental Age

Reynolds found a significantly positive relationship between auditory discrimination scores and mental age in his study with fourth

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[59] Thompson, op. cit., p. 87.

[60] Wepman, "Auditory Discrimination, Speech and Reading," p. 326.

[61] Deutsch, op. cit., p. 286.

[62] Reid, op. cit., p. 69.

[63] Dykstra, op. cit., p. 23.

grade subjects.[64] Gates and Thompson obtained similar results.[65]

Harrington, however, concluded from her study that mental age was not significantly related to auditory discrimination.[66] Templin also found that the correlations between mental age and the ability to make sound discriminations were not significant.[67] Reid obtained the same pattern for mental age as she had for IQ. Correlations between mental age and auditory discrimination scores were higher in October than at the end of the grade one year.[68]

Although the magnitude of the relationship between mental age and auditory discrimination is not certain, mental age was considered as a possible bias variable in the present investigation.

Preferred Sensory Modality

Wepman has suggested the possibility that a child's preferences among sensory modalities may affect his ability to make auditory discriminations. He claimed that educators approach all children as though they can learn equally well through the auditory mode. He felt that children whose auditory abilities developed late should be trained through their better developed sensory modalities until developmental processes come into balance.[69]

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[64] Reynolds, op. cit., p. 448.

[65] Gates, "A Further Evaluation of Reading Readiness Tests," p. 581; Thompson, op. cit., p. 87.

[66] Harrington, op. cit., p. 378.

[67] Templin, op. cit., p. 453.

[68] Reid, op. cit., p. 69.

[69] Wepman, "Auditory Discrimination, Speech and Reading," p. 332.

Although no experimental studies have considered the relationship between auditory discrimination and preferences among sensory modalities, it is possible that children who prefer their auditory mode may find it easier than those who prefer their visual or haptic mode to make auditory discriminations. Preferred sensory mode was not considered as a possible bias variable in the present study because the available standard test would be very time consuming with a sample of sixty children.

Chronological Age

Kennedy found in her study with disabled readers that the ability to make pitch discriminations increased with age.[70] Wepman, in a comparison of data for grades one and two children, found a decreasing number of children with poor auditory discrimination as age increased. He considered auditory discrimination to be a maturational factor which frequently matured as late as the end of the child's eighth year.[71] Wheeler and Wheeler suggested that beginners may make more use of auditory discrimination in learning to read than children at the upper elementary level.[72] Auditory discrimination might be more influential when word recognition and comprehension skills are being formulated than after these skills have been established.

Dykstra, however, found that correlations between chronological age and ability to make auditory discriminations were definitely not

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[70] Kennedy, op. cit., pp. 249-250.

[71] Wepman, "Auditory Discrimination, Speech and Reading," p. 326.

[72] Wheeler and Wheeler, op. cit., p. 111.

significant. The older first grade children exhibited no greater skill at making auditory discriminations than younger children.[73] Gates also found that correlations of blending and rhyming ability with chronological age were not significant.[74]

Research has produced conflicting results concerning the relationship between chronological age and auditory discrimination. Hence, chronological age was considered as a possible bias variabe in the present study.

Socio-Economic Status

Mortenson found that performance on discrimination tests was significantly related to the socio-economic status of beginning grade one children. Even when IQ was held constant, socio-economic status was significantly related to auditory discrimination.[75]

Clark and Richards conducted a study in low socio-economic areas. They found that economically disadvantaged children exhibited deficiencies in auditory discrimination abilities.[76]

Both studies suggest that there is a positive relationship between ability to make auditory discriminations and socio-economic status. Socio-economic status was included in the present study as a

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[73] Dykstra, op. cit., p. 33.

[74] Gates, "A Further Evaluation of Reading Readiness Tests," p. 581.

[75] W. P. Mortenson, "Differences in Performance of Beginning First Grade Pupils of Selected Economic Status and Sex," Dissertation Abstracts, 28:548, August, 1967.

[76] A. Clark and C. Richards, "Auditory Discrimination among Economically Disadvantaged and Non-Disadvantaged Pre-School Children," Exceptional Children, 33:262, 1966.

possible bias variable.

Summary

Several variables have been mentioned which are related to, and may affect ability to make auditory discriminations. The following have been included as possible bias variables in the present study: auditory acuity, sex, intelligence, mental age, chronological age, and socio-economic status. Bilingualism and preferred sensory modality could not be considered.

III. EFFECT OF AUDITORY TRAINING ON READING ACHIEVEMENT

Experimental studies concerning the merit of auditory training have been almost exclusively carried out under the supervision of Durrell at Boston University. One of the first to investigate the effectiveness of auditory training was Murphy.

Murphy's Doctoral Dissertation in 1943 was entitled An Evaluation of the Effect of Specific Training in Auditory and Visual Discrimination on Beginning Reading. A sample of 540 pupils from thirteen classrooms at the beginning of the grade one year were used in her experiment. The children were divided into four groups which were equated for chronological age, mental age, ability in visual and auditory discrimination, and rate of learning new words. The four groups were given daily ten minute instruction periods in auditory discrimination, visual discrimination, a combination of visual and auditory discrimination, or regular reading exercises. At the end of six weeks, all three experimental groups were significantly superior to the control group in reading achievement, but a combination of training in visual and auditory

discrimination brought the best results. Murphy noted that the effectiveness of the exercises was proportional to the need. Those initially low in auditory ability showed greater improvement in reading achievement than those initially high.[77]

Murphy's auditory discrimination lessons involved the subjects in such activities as listening to and volunteering words beginning with a particular sound, observing words written on the blackboard, finding pictures that began with a particular sound, and indicating what letter a particular word began with. These types of lessons not only train children to hear similarities among sounds but also to associate sounds with their corresponding letter symbols. Teaching sound-letter symbol relationships is probably beyond auditory discrimination and into the realm of phonics.

Two more investigations carried out at Boston University by Crossley and Bresnahan were reviewed by Durrell and Murphy in 1953.[78] They dealt with other methods of ear training. Crossley's study in 1948 evaluated the use of lantern slides to improve auditory and visual discrimination. The lantern slides showed familiar objects illustrating beginning and ending consonants, vowel sounds, and rhyming. At the end of her six week training period, Crossley's experimental group showed significant gains in reading achievement.

A second study by Bresnahan evaluated ten phonograph records

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[77] D. D. Durrell, H. B. Sullivan and H. A. Murphy, Building Word Power (New York: World Book Company, 1945), pp. 3-4.

[78] D. D. Durrell and H. A. Murphy, "The Auditory Discrimination Factor in Reading Readiness and Reading Disability," Education, 73:556-560, May, 1953.

designed to teach children to identify sounds in spoken words. She used 180 kindergarten children in the second half of their school year. After six weeks of special training, the experimental group made only slightly greater gains than the control group in the auditory analysis of word elements.

The studies cited by Durrell and Murphy are inconclusive concerning the effect of auditory training. Murphy and Crossley found that auditory training was effective in improving reading achievement, but Bresnahan found opposite results. Murphy's success may have been partially due to the provision for practice with sound-letter symbol associations in her auditory discrimination program. It is now necessary to provide an auditory discrimination program which eliminates all phonics teaching. This is what the present study attempted to do.

IV. SUMMARY

Experiments and studies dealing with the relationship of auditory discrimination to reading achievement revealed three types of auditory discrimination abilities to be related to reading achievement: ability to recognize or produce words containing a particular sound; ability to hear similarities and differences in speech sounds in words; and a composite of auditory discrimination abilities.

Several variables which may affect auditory discrimination were suggested. These were auditory acuity, sex, bilingualism, IQ, mental age, preferred sensory mode, chronological age, and socio-economic status.

Studies concerning the effect of auditory training on reading achievment were inconclusive. Therefore, the present study was conducted to determine the effect of a non-phonic auditory discrimination training program on reading achievement.

CHAPTER IV

CONSTRUCTION OF THE RESEARCH INSTRUMENT

The present study is concerned with the relationship between auditory discrimination and reading achievement. Hence, an auditory discrimination test was required which would yield results closely related to reading success and failure. The following chapter describes the construction of the research instrument.

I. TYPE OF MEASURING INSTRUMENT

Various tests which have been used to measure auditory discrimination were considered in Chapter III. Three types of auditory discrimination scores were found to be significantly related to reading achievement. There were: discrimination of similar sounds; composite auditory discrimination scores; and word pairs tests.

The tests used to measure ability to recognize or produce words with similar sounds, although significantly related to reading achievement, were found to yield inconsistent results in Dykstra's study. He included two subtests which measured ability to recognize words beginning or ending with particular sounds. His findings indicated that one of these subtests ranked second only to intelligence as far as its contribution to the prediction of reading achievement was concerned, while the other failed to make any significant contribution to the prediction.[1]

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[1] G. Dykstra, "Auditory Discrimination and Beginning Reading," Reading Research Quarterly, 1:31-32, Spring, 1966.

Another problem with tests which measured the ability to recognize or produce words with similar sounds, was that they frequently involved the use of visual stimuli. They also depended to some degree on the pupil's ability to recognize pictures, or the number of words he had for recall. Hence, this type of test did not appear to be an adequate device for measuring auditory discrimination and was not used in the present study.

Correlations between composite auditory discrimination scores and achievement in reading were also consistently significant. Dykstra found in his study, however, that there was little justification for giving more than one or two short auditory discrimination measures. He stated that "very little improvement in the accuracy of prediction can be expected as a result of giving an entire battery of auditory discrimination tests...."[2] To avoid giving tests which would add little to the relationship between reading achievement and ability to make auditory discriminations, a battery of tests was not chosen as the measuring instrument in this study.

Most of the studies using a word pairs test of auditory discrimination found significant correlations between auditory discrimination and reading. All the studies which used the Wepman Auditory Discrimination Test found significantly positive correlations. Hence, the Wepman test appeared to be a useful instrument for identifying pupils whose inadequate auditory discrimination was interfering with their reading achievement. The relatively low correlations found by some of the investigators, however, may indicate that some of Wepman's

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[2] Ibid., p. 32.

items did not clearly discriminate between subjects with good and poor auditory discrimination. It was on this supposition that a revised word pairs test was devised.

II. DEFINITIONS FOR THE CONSTRUCTION OF THE RESEARCH INSTRUMENT

For the purpose of constructing items on the revised auditory discrimination test, the following definitions were used:[3]

Phonemes are the significant sounds of speech which signal meaning.

Stops are consonant sounds produced by a complete stoppage of the out-going air-stream. (/b,d,g/ and /p,t,k/)

Fricatives are consonant sounds produced by bringing an articulator so close to the point of articulation that the air passing between them produces a frictional noise. (/θ,f,s,š,h/ and /ð,v,z,ž/)

Affricates are stops with a release sufficiently slow to produce a momentary fricative effect before the next sound begins. (/č,ǰ/)

Nasals are consonant sounds produced by the stoppage of the oral cavity and the free passage of air and sound through the nasal cavity. (/n,m,ŋ/)

Laterals are consonant sounds produced by closing off most of the mouth by pressing the tongue against the roof of the mouth while leaving an

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[3]W. N. Francis, The Structure of American English (New York: The Ronald Press Company, 1958, pp. 30-85.

opening on one or both sides. (/l/)

Semivowels are consonant sounds which consist of a rapid movement of the articulators from a characteristic initial position to the position for the vowel that follows, or the reverse. (/w,y,r/)

Voicing. Speech sounds produced while the vocal bands are vibrating are said to be voiced. Speech sounds produced with an unobstructed passage of air (open glottis) are said to be voiceless.

III. CHOICE OF ITEMS FOR THE REVISED TEST INSTRUMENT

An analysis of items on the Wepman Auditory Discrimination Test will be given to indicate items included and excluded by Wepman. Criteria for the choice of items on the research instrument will then be presented with a list of the items constructed according to these criteria. Finally, the word controls used for each item will be described.

Analysis of Items on the Wepman Auditory Discrimination Test

An analytical breakdown of the Wepman Auditory Discrimination Test revealed that Wepman made all the possible comparisons between voiceless stops, between voiced stops, and between voiceless fricatives. He did not include: the velar nasal /ŋ/; the alveolar and alveopalatal voiced fricatives /z,ž/; the affricates /č,ǰ/; the semivowels /r,w,y/; or the lateral /l/. Wepman made few comparisons involving voiced fricatives or vowels and did not make any comparisons in the medial position of words. No indication of the criteria used for choosing items was given in Wepman's Manual of Directions for Auditory

Discrimination Test.[4]

Criteria for the Choice of Items on the Research Instrument

Little evidence is available concerning the sounds which are normally discriminated and those which are not at any age level. Provost and Dumbleton attempted to place the sound contrasts on their Picture-Type Speech Sound Discrimination Test in order of difficulty for grade one subjects. However, they felt that no definite conclusions could be drawn concerning the order of difficulty on their test. Only one word pair for each sound contrast was included and Provost and Dumbleton felt it was "impossible to consider a specific sound pair to be adequately represented by any one particular word pair in which it may be represented".[5]

Articulation Errors. A search for information relevant to the choice of items on the revised auditory discrimination test turned to the area of articulation since a close relationship between articulation and auditory discrimination had been noted in Chapter II. Templin carried out an extensive study of the articulatory errors of children from ages three to eight. The results of her study as well as those of Poole and Wellman are shown in Table X taken from Templin's book Certain Language Skills in Children.

The maximum ages at which sounds could be articulated correctly

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[4] J. Wepman, Manual of Directions for Auditory Discrimination Test (Chicago: University of Chicago, 1958).

[5] W. Provost and C. Dumbleton, "A Picture-Type Speech Sound Discrimination Test," Journal of Speech and Hearing Disorders, 18:262, September, 1953.

TABLE X

COMPARISON OF THE AGES AT WHICH 75 PER CENT OF THE SUBJECTS CORRECTLY PRODUCED SPECIFIC CONSONANT SOUNDS IN THE TEMPLIN, THE WELLMAN, AND THE POOLE STUDIES[6]

Sound	Templin	Wellman	Poole	Sound	Templin	Wellman	Poole
m	3	3	3.5	r	4	5	7.5
n	3	3	4.5	s	4.5	5	7.5
ng	3		4.5	sh	4.5		6.5
p	3	4	3.5	ch	4.5	5	
f	3	3	5.5	t	6	5	4.5
h	3	3	3.5	th	6		7.5
w	3	3	3.5	v	6	5	6.5
y	3.5	4	4.5	l	6	4	6.5
k	4	4	4.5	~~th~~	7		6.5
b	4	3	3.5	z	7	5	7.5
d	4	5	4.5	zh	7		6.5
g	4	4	4.5	j	7	6	

differed slightly in the three studies, but generally nasals, most of the stops, and some of the semivowels /w,y/ were mastered early. Fricatives, affricates, the semivowel /r/, and the lateral /l/ appeared to be mastered later.

Templin also found that more articulatory errors were made in the medial and final than in the initial position of words. Most errors occurred in the final position.[7] She outlined each sound in the various positions and indicated the percentage of children at each age who had mastered the sound.[8] Templin's work provided one of the criteria for choice of items in the revised Fast-Cosens Auditory Discrimination

[6]M. C. Templin, Certain Language Skills in Children (Minneapolis: The University of Minnesota Press, 1957, p. 53.

[7]*Ibid.*, pp. 44-45.

[8]*Ibid.*, pp. 166-169.

Test. Consideration was given to all sounds in any position which 5 per cent of the children could not articulate by age six. This relatively high standard was chosen so all difficult sounds would be included on the initial version of the research instrument.

Discrimination Errors. The second basis for choice of items on the auditory discrimination test was the work of Miller and Nicely reported in Chapter II. They indicated that voicing and nasality were the most discriminable features of speech sounds and that friction, duration,and place of articulation were much less discriminable. Hence, in constructing the Fast-Cosens Auditory Discrimination Test, no items were included which required discriminiations between voiced and voiceless sounds, or between nasal and non-nasal consonant sounds. Items were chosen which required discriminations involving friction, duration, and place of articulation.

Frequency of Phonemes in Words. The third criteria for choosing items was the frequency of specific phonemes in words. Miller indicated that some consonants are generally used in the initial position of words, while others are used more extensively at the end. "Only five different sounds make up more than 50 per cent of our final consonants, while eight are needed to comprise 50 per cent of our initial consonants."[9] Some consonants are very rare and so these were involved in few items on the discrimination test.

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[9]G. Miller, Language and Communication (Toronto: McGraw-Hill Book Company, Inc., 1951), pp. 86-88.

Items Included on the Research Instrument

Using the above three criteria, the following items were included in the Fast-Cosens Auditory Discrimination Test:

1. Comparisons of the velar nasal /ŋ/ with other nasals in the medial and final position;

Templin found that the bilabial /m/ and alveolar /n/ nasals were mastered by 96.7 to 100 per cent of her six year old subjects. The velar /ŋ/, however, was not mastered by 95 per cent of the six year olds and was difficult for some of the seven year old subjects. Nasals were not compared with other sound types because Miller and Nicely found nasality a relatively easy feature of speech sounds to discriminate.

2. Every possible comparison among voiced fricatives except those with /ž/;

None of the voiced fricatives in any position were mastered by 95 per cent of Templin's six year old subjects. The fricative /ž/ was included in only a few comparisons because Miller found /ž/ to be the rarest consonant phoneme in his study.

3. Every possible comparison among voiceless fricatives except those with /h/;

Few of the voiceless fricatives were mastered by 95 per cent of Templin's sample aged six years. The glottal fricative /h/, however, was mastered by 98 to 100 per cent of her sample.

4. Some comparisons of fricatives with non-fricatives in similar places of articulation;

Miller and Nicely's study indicated that friction was a relatively difficult feature to discriminate. Comparisons used in test items were based on the confusion matrices of Miller and Nicely.

5. Comparisons of affricates with fricatives in similar places of articulation;

The affricates were not mastered by 95 per cent of Templin's sample at age six.

6. Comparisons between the semivowels /r,w/ and the lateral /l/;

The semivowel /r/ and the lateral /l/ were not mastered by 95 per cent of Templin's six year old sample.

7. Comparisons among voiceless stops in the medial and final positions, and among voiced stops in the final position.

Templin found that stops in the initial and medial word positions were mastered earlier than those in the final position. She also found that voiced stops were easier than voiceless stops.

Since Templin found that all vowels and diphthongs were articulated correctly by 95 per cent of her sample by age six, comparisons among vowels were excluded from the test.

During actual construction of the minimal pairs containing the contrasts listed above, the work of Liberman and others at the Haskin's laboratories was kept in mind. Words containing a variety of vowel sounds following the consonant to be discriminated were chosen.

To cut down the influence of chance with probably affected the results of Wepman's test, four minimal word pairs and four like word pairs for each contrast of phonemes were originally constructed for most comparisons. When minimal pairs were very difficult to construct for a comparison, only two or three items were included.

Word Controls

Two word controls were exercised on the construction of the items. The Gage Dictionary of Canadian English, the Beginning Dictionary was used as the authority on pronunciation to determine whether or not the

contrasts were actual minimal pairs.[10] The second control involved a frequency control. Each of the words in a minimal pair were matched for familiarity by selecting words as close to each other in frequency as possible from the Lorge-Thorndike Teacher's Word Book of 30,000 Words.[11] This word list was used because it gave a frequency count of words actually included in reading materials and the intent of the Fast-Cosens Auditory Discrimination Test was to pin point trouble spots in auditory discrimination which affect reading achievement. Words familiar to primary students were preferred in test items.

Validity

Content validity for the Fast-Cosens Auditory Discrimination Test was established by basing the choice of items on discrimination errors, articulation errors, and frequency of consonant sounds using research evidence from Miller, Nicely, and Templin.

IV. THE PILOT STUDY

A pilot study was conducted in the middle of March to indicate which test items discriminated between subjects with good and those with poor auditory discrimination. It also suggested desirable refinements in the administration of the instrument.

The revised test consisting of 398 items including four minimal word pairs and four like word pairs for most sound contrasts indicated

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[10]M. H. Scargill et al., Dictionary of Canadian English: The Beginning Dictionary (Toronto: W. J. Gage Limited, 1962).

[11]E. L. Thorndike and I. L. Lorge, The Teacher's Word Book of 30,000 Words (New York: Teacher's College, Columbia University, 1944).

above was administered to thirty-two students from two schools assigned to the investigator and a co-worker by the Edmonton Public School Board. One school was in a low socio-economic area and the other was in a middle socio-economic area.

The results of the pilot project were subjected to a Test Item Analysis computer program processed by the Computing Center at the University of Alberta, Edmonton. Each item was then evaluated using the difficulty index, the biserial correlation, and the reliability index as criteria. The difficulty index indicates the proportion of subjects who make a correct response to a particular item.[12] Biserial correlation is an index of item validity, the extent to which an item discriminates among examinees. Biserial correlation gives the correlation of an item with the total score on the test.[13] The reliability index is defined by Magnusson as a measure of an item's contribution to the total test variance.[14] Reliability generally refers to the stability of scores over a period of time rather than internal consistency. The overall reliability (internal consistency) of the Fast-Cosens Auditory Discrimination Test was .95.

The difficulty index was considered as the main criteria for selecting items to retain in the final revision. Difficulty indices were corrected for chance according to Guilford,[15] and an attempt was

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[12]H. E. Garrett, Statistics in Psychology and Education (Toronto: Longmans, Green and Co., 1958), p. 363.

[13]Ibid., p. 365.

[14]D. Magnusson, Test Theory (Don Mills, Ontario: Addison-Wesley Publishing Company, 1966), p. 214.

[15]J. P. Guilford, Psychometric Methods (Toronto: McGraw-Hill Book Company, Inc., 1954), p. 421.

made to retain items with corrected difficulty indices between .25 and .75. Since a standard number of items was considered desirable for each phonemic contrast, the best three like and the best three unlike word pairs were retained where this was possible. Two like and two unlike items were retained if there were only two items in the original revision. Hence, some difficulty indices for unlike word pairs fell outside the desired range as shown in Figure 2.

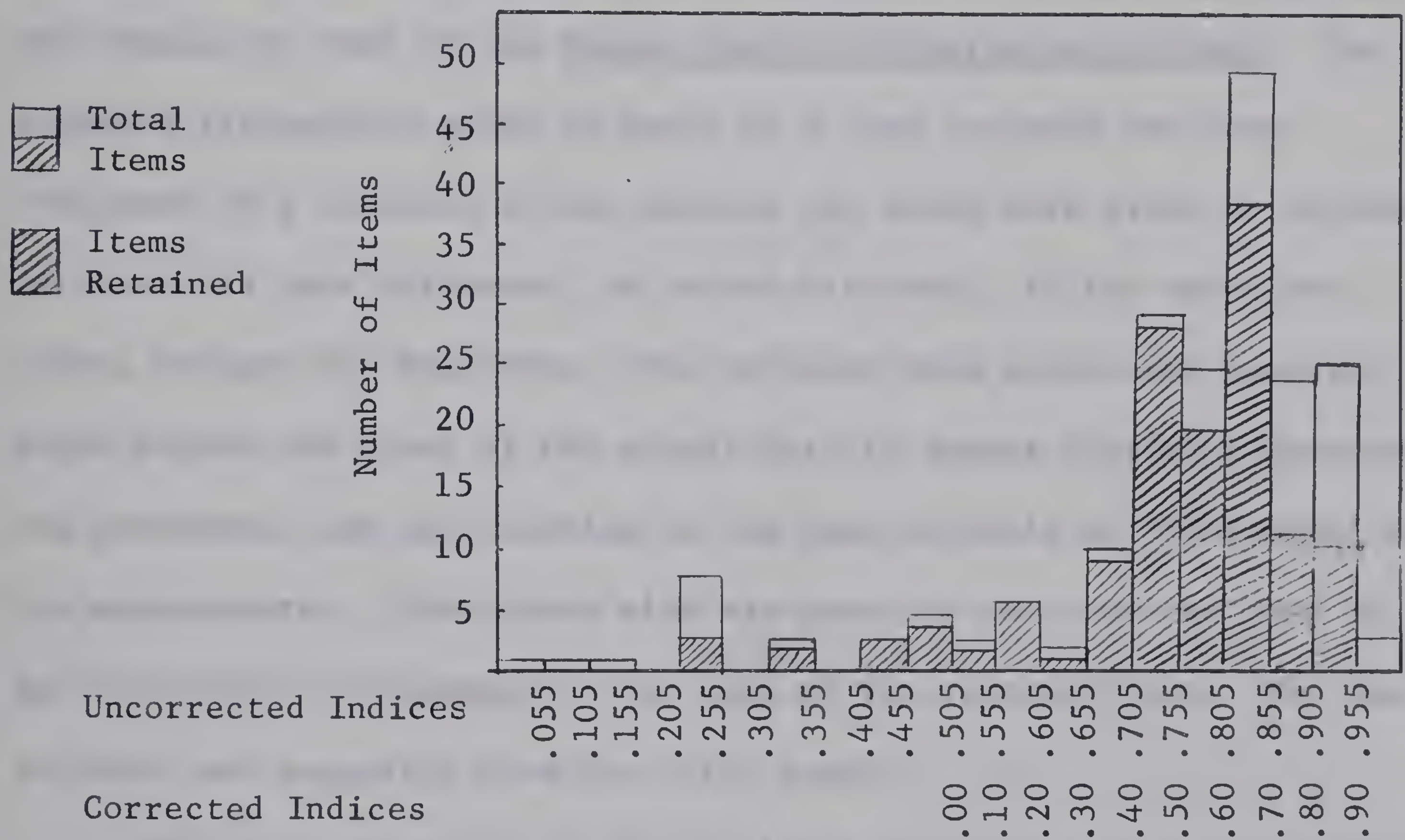

FIGURE 2

DIFFICULTY INDICES FOR UNLIKE PAIRS

The total bar indicates the number of unlike pairs with each difficulty index. The shaded portion indicates the number of items retained in the final test. Approximately one-fourth of the contrasts were outside the .25 to .75 range of difficulty. Like pairs tended to have higher difficulty indices with the result that many of the like

pairs retained were relatively easy. The graph would be shaped much the same as the graph for unlike pairs only with greater skewedness.

The final test consisted of 266 items. These were arranged in random order using a table of random numbers. The complete test is included in Appendix A.

V. ADMINISTRATION OF THE TEST

Administration of the Fast-Cosens Auditory Discrimination Test was similar to that of the Wepman Auditory Discrimination Test. The examinee listened to pairs of words on a tape recorder and then indicated by a concrete action whether the words were alike or different. If the words were different, he raised his hand. If the words were alike, he kept his hand down. The subjects were given some practice pairs before the onset of the actual test to ensure that they understood the procedure, and were working on the same criteria of 'different' as the experimenter. There were also six practice pairs on the tape to get the subject accustomed to the pace of the recorded test. The need for this was suggested from the pilot study.

The test was given in two 15 minute sessions with a five minute break between them. All items were presented on a tape recorder to ensure that each word pair was heard with the same quality, pitch, stress, and interval by all subjects. This provided consistency of presentation and prevented the subjects from getting visual clues from the position of articulation of the administrator. Responses were marked by the examiners on IBM marking sheets.

The recording was made in a sound proof room by a co-worker who

came from a one language, Western Canadian, English background.

Auditory discrimination tests were administered by the investigator and one assistant during the first two weeks of May. Pupils were tested in groups of four to six with dividers between them to prevent them from observing one another's response. Testing was conducted in medical rooms which were generally fairly quiet. Subjects were reevaluated on the Fast-Cosens Auditory Discrimination Test during the second last week of June. The actual instructions and practice items used are included with the Fast-Cosens Auditory Discrimination Test in Appendix A.

VI. SUMMARY

A revised word pairs test was chosen as the research instrument for the present study. Items were constructed on the basis of articulation errors, discrimination errors and frequency of phonemes in words. Word controls for familiarity and pronunciation were exercised on all items. A pilot study was conducted and the results were subjected to a test item analysis to determine which items to retain in the final revision. The auditory discrimination test was administered on a tape recorder and pupils responded with concrete actions.

CHAPTER V

THE EXPERIMENTAL DESIGN

This chapter will describe the design of the study, the testing instruments, the training program, and the statistical treatment of the data obtained.

I. THE DESIGN OF THE STUDY

The present study was a pretest-posttest control group design. This type of design is highly recommended by Campbell and Stanley who feel that it adequately controls for most of the factors which affect the internal validity of a study.[1] The present study involved a comparison of thirty subjects given training in auditory discrimination with thirty subjects not given training. All subjects were from a large urban center.

The pretest battery included tests for auditory discrimination, auditory acuity, and oral and silent reading. These tests were administered from May 1 to May 17, 1968. Intelligence tests were also given from June 10 to June 20.

The treatment consisted of a four week training program from May 21 to June 14.

Posttests were administered from June 17 to June 25 to evaluate improvement in auditory discrimination, and in oral and silent reading.

The following reader characteristics were considered as possible

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[1] D. T. Campbell and J. C. Stanley, Experimental and Quasi-Experimental Designs for Research (Chicago: Rand McNally & Company, 1966), pp. 13-16.

bias variables in the study: auditory acuity, sex, intelligence, mental age, chronological age, and socio-economic status.

All tests were marked and all the results analysed by the investigator.

II. THE TEST SAMPLE

The test sample was drawn from grade one pupils in two elementary schools which were assigned to the investigator by officials of the Edmonton Public School Board. Both schools were identified by school officials as being in middle socio-economic areas, a deliberate choice to control the influence of socio-economic status to some extent. Two classrooms from each school were selected by school personnel providing an initial test population of 117 subjects. The selection of the final test sample was based on auditory discrimination needs and auditory acuity.

Auditory Discrimination of Students in the Test Population

The 117 subjects in the test population were administered the Fast-Cosens Auditory Discrimination Test. Scores on this discrimination test were used to rank the pupils on ability to make auditory discriminations. Mean scores on the auditory discrimination test as well as the mean chronological age of the population of 117 subjects are shown in Table XI. There were 266 items on the Fast-Cosens Auditory Discrimination Test. Scores are shown for each classroom, each school, and for the total group. Table XI indicates that there was little difference between classrooms or schools in mean chronological age, but that there was considerable difference in ability to make auditory discriminations.

TABLE XI

MEAN CHRONOLOGICAL AGE AND MEAN AUDITORY DISCRIMINATION SCORE OF THE TOTAL POPULATION

School	Classroom	Auditory Discrimination	Chronological Age (months)
I	A	224.5	81.8
I	B	231.2	83.8
I	A + B	227.7	82.7
II	C	224.8	82.4
II	D	211.4	82.3
II	C + D	218.0	82.4
I + II	A + B + C + D	222.6	82.5

Mean scores of classrooms ranged from 211 to 231 correct responses and individual scores ranged from 154 to 257 correct responses.

Pupils who scored below the 60th percentile on the Fast-Cosens Auditory Discrimination Test were considered for inclusion in the sample for this study. Because there are conflicting opinions as to whether auditory acuity affects ability to make auditory discriminations, it was decided to eliminate pupils who could not pass an individual audiometer test. Standards were set so only those with losses of over thirty decibels at one or more frequencies were eliminated. This standard was chosen by the researcher since tests were not given in a sound proof room and the retention of auditory acuity as an independent variable in this study was considered desirable.

Of the seventy-two subjects below the 60th percentile on the auditory discrimination test, twelve were eliminated because they had

hearing losses of more than thirty decibels. Several others were considered to have borderline hearing if they had losses of twenty-five decibels at two or more frequencies or losses of thirty decibels at one or more frequencies. The distribution of pupils in the four classrooms on the audiometer test is shown in Table XII.

TABLE XII

AUDITORY ACUITY OF THE TEST POPULATION

Acuity	Classrooms A	B	C	D	Total
Good	12	11	7	16	46
Poor*	2	0	5	5	12
Borderline	2	3	6	3	14
Total	16	14	18	24	72

*Hearing loss of twenty decibels at two or more frequencies or thirty decibels at one or more frequencies

These findings suggest that there is a need for the provision of hearing tests at the grade one level because too many children are attempting to function in normal classroom situations with hearing losses or borderline acuity. Thirty-six per cent of the subjects in this test population had inadequate auditory acuity.

The sixty subjects who passed the auditory acuity test constituted the final test sample for the investigation.

<u>Socio-Economic Status of Subjects in the Test Population and Sample</u>

All subjects in the test population were attending schools in middle socio-economic districts but since studies have suggested that

socio-economic status may affect ability to make auditory discriminations, this variable was considered more carefully. Cumulative record cards were used to determine fathers' occupation and these were ranked according to the Occupational Class Scale developed by Blishen. Blishen used data from the decennial census of 1951 to construct his occupational scale, and although his book Canadian Society was revised in 1960, no changes in the class scale were indicated. All occupations were ranked in terms of average income and average number of years of schooling required. After all occupations were ranked, Blishen somewhat arbitrarily divided the occupations into seven classes with his awareness of prestige as a major factor in the classification.[2]

Figures 3 and 4 indicate that there was considerable diversity in socio-economic status among the population involved in this study. The open bar indicates the socio-economic status of the total test population and the shaded bar indicates the socio-economic status of those in the final sample of sixty. Unfortunately, some children were not included in Figures 3 and 4 since their fathers' occupation could not be classified by the Occupational Class Scale from information included on the cumulative record cards in the schools. In homes without a father, the mother's occupation was used to determine socio-economic status.

The final test sample of sixty subjects was representative of all socio-economic groups in the test population. Only those with a socio-economic rating of six were disproportionately represented in the test

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[2] B. Blishen et al., Canadian Society: Sociological Perspectives (Toronto: The MacMillan Company of Canada, Ltd., 1961), pp. 477-484.

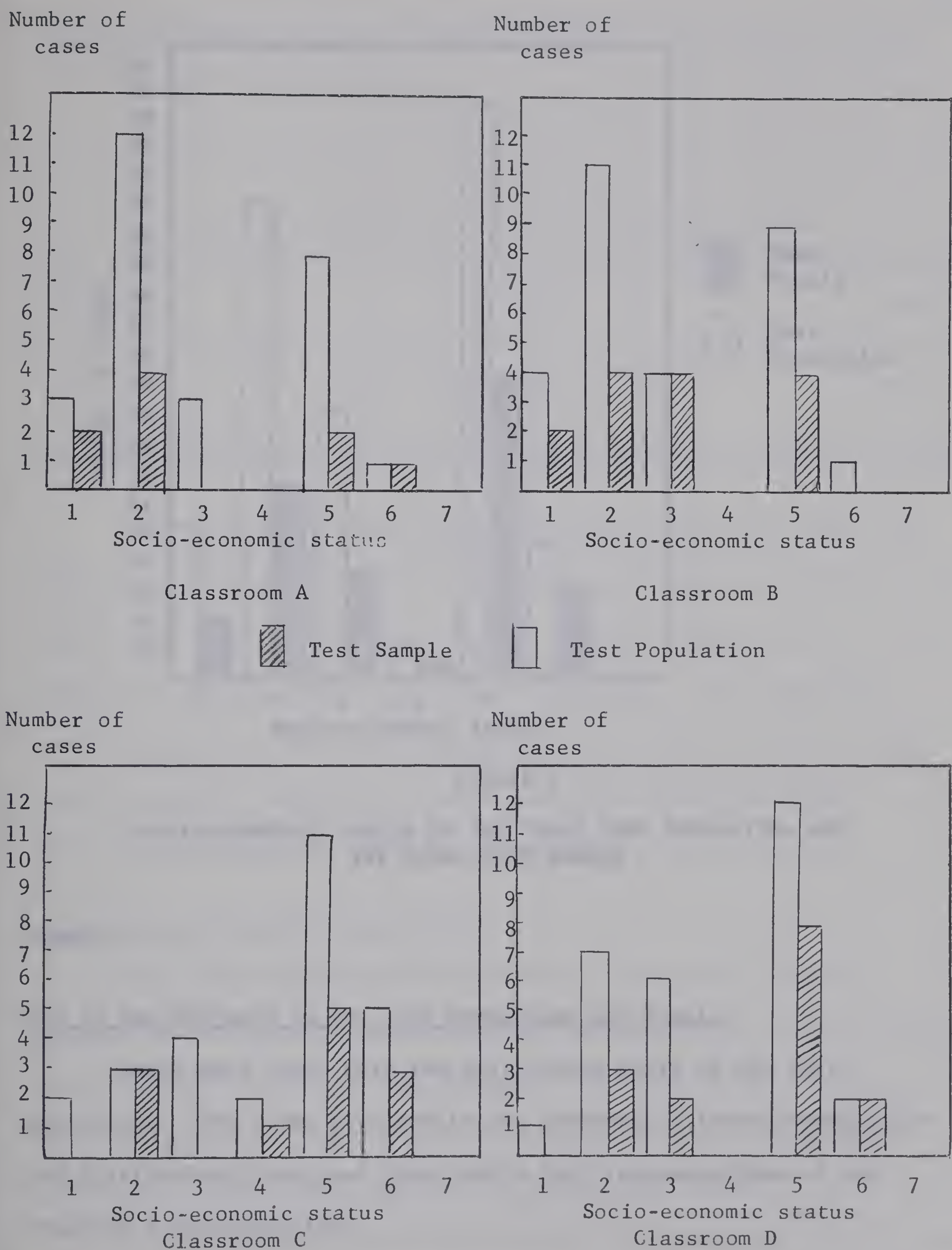

FIGURE 3

SOCIO-ECONOMIC STATUS OF THE TOTAL TEST POPULATION AND THE FINAL TEST SAMPLE BY CLASSROOMS

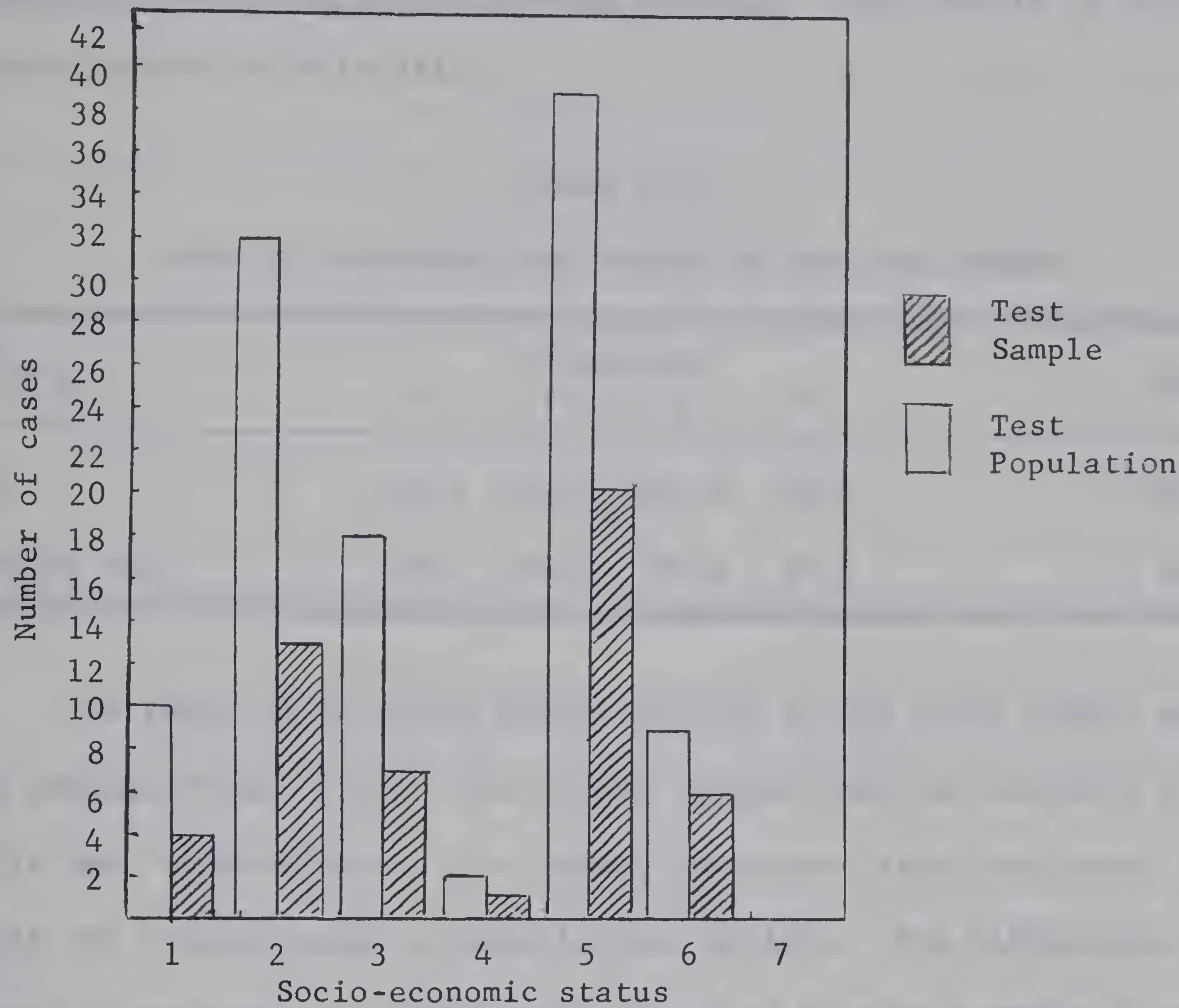

FIGURE 4

SOCIO-ECONOMIC STATUS OF THE TOTAL TEST POPULATION AND THE FINAL TEST SAMPLE

sample.

Sex of the Subjects in the Test Population and Sample

There were sixty boys and fifty-seven girls in the test population. The final test sample was composed of twenty-seven girls and thirty-three boys, and hence, was a fair representation of the original test population.

Mental Maturity of Pupils in the Test Sample

All pupils in the final test sample were administered the

California Short-Form Test of Mental Maturity. The results of this test are shown in Table XIII.

TABLE XIII

MEAN IQ AND MENTAL AGE SCORES OF THE TEST SAMPLE

Scores	Classrooms A	B	C	D	Total
IQ	108.5	106.5	106.0	102.3	105.5
Mental Age	88.9	89.9	91.8	85.3	88.7

The range of IQ scores among subjects in the total sample was from seventy-three to 135. The scores suggest that the subjects in the sample were representative of a normal population since the means fell within the average range of intellectual ability. The differences between classrooms were slight with classroom D being somewhat lower than the others. Mental age scores similarily indicated slight differences between the different classrooms.

Composition of the Treatment Groups

The sixty subjects in the final test sample were randomly assigned to the control and experimental groups. This resulted in two groups similar on most of the variables considered in this study. Table XIV depicts a comparison of the groups in terms of mean IQ, mental age, chronological age, and socio-economic status.

The experimental group was composed of sixteen boys and fourteen girls and the control group was composed of seventeen boys and thirteen girls.

TABLE XIV

MEAN IQ, MENTAL AGE, CHRONOLOGICAL AGE AND SOCIO-ECONOMIC STATUS OF TREATMENT GROUPS

Means	Experimental Group	Control Group
IQ	104.92	109.76
Mental Age	88.58	91.32
Chronological Age	82.32	83.48
Socio-Economic Status	4.02	4.44

The groups differed slightly in terms of auditory acuity. The experimental group had four and the control group had nine subjects with borderline acuity.

<u>Summary</u>

Subjects for the experimental study were grade one pupils from classrooms in two schools selected by officials of the Edmonton Public School Board. Subjects below the 60th percentile on the <u>Fast-Cosens Auditory Discrimination Test</u> were given individual audiometer tests. The sixty subjects who passed the audiometer test constituted the final test sample. There was little difference between schools or classrooms in chronological age, IQ, or mental age, but substantial differences in ability to make auditory discriminations, auditory acuity, and socio-economic ratings. Results of a mental maturity test indicated that the test sample was within the normal range of intellectual ability. Differences between the treatment groups were slight.

III. TESTING INSTRUMENTS

The tests which will be described in this section are the auditory tests, reading tests, and the intelligence test used in this study.

Auditory Tests

Auditory Acuity. Two Maico audiometers were used to measure auditory acuity. The Maico Audiometer is a portable instrument equipped with ear phones which measures hearing loss for pure tones of various frequencies. Frequencies of 250, 500, 1000, 2000, 4000, and 8000 were tested in this study. The audiometer is constructed so zero decibel hearing loss is the intensity required to reach the threshold of the average ear 50 per cent of the time. The intensity is controlled and graduated in five decibel steps. Hearing loss is expressed as the number of decibels in excess of the zero point.[3]

Audiometer tests were administered individually by the investigator and one assistant. The child was seated with his back to the examiner and was asked to indicate whether or not he could hear the sound by raising or lowering his fingers. After an explanation was given, practice was provided at a high intensity to ensure that the child was attending to the right stimulus and that he knew how to indicate his response.

Each frequency was tested by first decreasing the intensity until the subjects could no longer hear the sound and then increasing the

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[3] H. A. Newby, Audiology (New York: Appleton-Century-Crofts, Inc., 1958), p. 64.

intensity until he could hear it again. The results for each ear were recorded on an audiogram.

Auditory Discrimination. Auditory discrimination was measured by the Fast-Cosens Auditory Discrimination Test. The construction and administration of this test were described in Chapter IV.

Reading Tests

Although many of the abilities involved in oral and silent reading are common, a few abilities such as oral production are specific to one type of reading achievement. Hence, both oral and silent reading were measured in the present investigation and it was felt they might bear different relationships to auditory discrimination.

Oral Reading. The Gray Oral Reading Tests are designed to provide an objective measure of the level of achievement in oral reading from early first grade to college level. Each form consists of a series of passages which increase in difficulty. Three objective measures are recorded for each passage.

Accuracy of oral reading is measured by having the examinee read each passage aloud while the examiner records refusals, gross and partial mispronunciations, omissions, substitutions, repetitions, and inversions. The subject continues reading until seven or more errors are made on two successive passages.

The time taken to read each passage is also recorded. The total number of errors and the time taken are combined to provide a total passage score. In addition, four comprehension questions are asked which require a literal meaning of each passage.

Tentative standardization of norms for the four forms of the <u>Gray Oral Reading Tests</u> was performed with pupils from four elementary schools, and six junior and senior high schools in Flordia. Coefficients of intercorrelation among grade scores on each of the forms at each grade level provided a measurement of reliability. These coefficients ranged from .973 to .982 which the test designers felt were highly satisfactory.

Form A of the <u>Gray Oral Reading Tests</u> was administered during the third week in May to all subjects included in the final sample. Oral reading achievement was reevaluated during the last two weeks of June by the administration of <u>Gray Oral Reading Tests</u>, Form B.

All tests were administered individually by the investigator. A copy of both Forms A and B is included in Appendix D.

<u>Silent Reading</u>. The <u>Lee-Clark Reading Test</u>, First Reader, attempts to objectively determine the silent reading ability of pupils. The first reader level is designed especially for pupils above average in reading achievement near the end of grade one. Hence, it was fairly difficult for several pupils in the sample, but was used so very good pupils could show improvement in performance between testing sessions.

The first reader test consists of five sections which measure both word recognition and comprehension. Word recognition is measured by two tests. In Part 1, words are spoken by the examiner and the pupil responds by marking the word spoken. In Part 2, visual stimuli are presented and the pupil matches words and pictures. Part 2 measures the pupil's basic vocabulary and his ability to recognize the meanings of words.

Three tests are provided to measure comprehension. Part 3, following directions, requires the pupil to read sentences and mark pictures according to the directions given in the sentences. Part 4, completion, requires the pupil to read with sufficient comprehension to choose the word which completes a sentence. Part 5, inferences, consists of several two sentence stories in which the pupil must select the word which completes the second sentence. This requires that the two sentences be integrated.

A coefficient of reliability for the Lee-Clark Reading Test of .90 was obtained by an alternate forms administration of the test.

The Lee-Clark Reading Test, Form A, was administered during the third week of May to small groups of subjects by the investigator. A reevaluation of silent reading ability was made during the final week of June on the Lee-Clark Reading Test, Form B. A copy of both Forms A and B is included in Appendix D.

Intelligence Test

The California Short-Form Test of Mental Maturity, Level 1, provides information about the functional capacities of pupils that are basic to learning, problem solving, and responding to new situations. This test was selected because it was one of the few tests which provides both a language and a non-language score at the grade one level. This was considered desirable in the present study because of the relationship between language development and auditory discrimination discussed in Chapter II.

The California Short-Form Test of Mental Maturity consists of seven sections. The first four measure non-language abilities such as

the ability of students to recognize opposites, similarities, analogies, and numerical values. The final three sections measure language abilities by tests including number problems, verbal comprehension, and delayed recall.

The entire test is administered in a single sitting and takes approximately one hour, with fourty-one minutes of actual working time.

The California Short-Form Test of Mental Maturity was administered to small groups of subjects by the investigator during the second and third weeks in June. A copy of the test is included in Appendix D.

IV. TRAINING PROGRAM IN AUDITORY DISCRIMINATION

A word pairs type of exercise was developed for the training program for two main reasons. First, the ability to hear likenesses and differences in speech sounds as measured by a word pairs test was one of the aspects of auditory discrimination most closely related to reading achievement. Second, psychologists have found that the opportunity to compare stimuli fosters the learning of a discriminatory task. The actual items for the exercises were constructed on the same criteria as the items for the Fast-Cosens Auditory Discrimination Test and hence, were parallel although they rarely overlapped those included on the discrimination test.

The word pair exercises included both frequent and hence, familiar words and infrequent, unfamiliar words. This is in line with the findings of McNeil and Stone. The results of their study indicated that children can learn to identify sounds in spoken words better through practice with nonsense words than familiar words. McNeil and Stone

believed this occurred because the task of responding to the individual sounds in a word was not familiar to the child. A child generally responds to a familiar word as a unit rather than as a sequence of separate sounds.[4] They recommended using nonsense words but since the ability to discriminate likenesses and differences in sounds in nonsense words was not found to be closely related to reading achievement in Chapter III, some unfamiliar words were included instead.

Some very easy items were also included to encourage a feeling of success by the pupils low in auditory discrimination ability. These usually involved consonant blends and vowel phonemic contrasts.

Four basic types of lessons were developed for the training period. The first type consisted of unlike word pairs depicted in pictures. The child was required to mark the picture named by the speaker on the tape.

The second type of lesson involved a simulated race. Five animals were racing. Four animals of the same type were running on each track. Word pairs were given and the pupil was instructed to mark an animal if the word pair was a contrast and to do nothing if the word pair was a like pair. When all four animals on one track had an X on them, a winner was declared.

The third type of exercise was similar to the first but was changed somewhat by the addition of the concept of multiple meanings. The pupil was presented with four pictures, some of which were unlike

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[4] J. D. McNeil and J. Stone, "Note on Teaching Children to Hear Separate Sounds in Spoken Words," Journal of Educational Psychology, 56:14, 1965.

word pairs and some of which were like word pairs. A word was pronounced and the child was required to mark all the pictures named by the word. This involved marking one or two pictures rather than just one as in the first exercise.

The final type of exercise involved a modified form of bingo. Unlike or like word pairs were read and the pupil responded by marking an X in a specified box if the words were different, or leaving the box empty if the words were the same.

Each item on the last three types of exercises was corrected immediately to prevent the game situation from interfering with learning to discriminate sounds.

The four types of lessons were compiled in an orderly sequence. The original plan was to present the first type of exercise on Mondays and Wednesdays, the second type of Tuesdays, the third type on Thursdays, and bingo on Fridays. School holidays and special classroom activities interfered with the orderly presentation of lessons, however, with the result that children did not appear to realize a sequence was intended.

The full set of exercises plus a detailed set of instructions for them are included in Appendix B.

The training period lasted four weeks with the experimental group receiving taped training in auditory discrimination every day. Each subject in the experimental group was provided with a booklet of exercises of the four types outlined above. Lessons were approximately ten minutes long and were presented at listening centers in the classroom under the supervision of either the investigator or the regular classroom teacher. All tapes were recorded by the investigator.

To reduce the possibility that taped instruction rather than training in auditory discrimination was the crucial factor, a group listened at a listening center for approximately ten minutes per day to a recorded story while they followed in their books. A parallel reader in a series other than the one being used in regular classroom instruction was selected and used for this purpose.

Since subjects were assigned randomly to the experimental and control groups, members of both groups were included in each classroom. Hence, two 10 minute sessions were required each day in all four classrooms. These two sessions ran consecutively with the experimental group usually first. Since only ten minutes intervened between the first and second session, it was not considered necessary to alternate times. It was felt that this would be too confusing and that it would be better to cater to the need of grade one pupils for order and routine. Sessions were held during the morning at one school and in the afternoon at the other school to enable the investigator to supervise lessons at both schools.

V. STATISTICAL TREATMENT OF DATA

The results obtained from both testing programs were recorded and examined. The information was processed by the Computing Center at the University of Alberta, Edmonton as outlined below.

T-tests for the Significance of Differences Between Means

Two types of t-test programs were run. The first involved a correlated t-test for the significance of differences between the performance of the total test group on one type of sound as compared to

another. The second, involved a t-test for the significance of differences between the mean scores on specific sound types of boys and girls, old and young, and high and low socio-economic groups. Means and standard deviations were obtained from the output of both programs.

Multiple Linear Regression

Multiple linear regression models were constructed as outlined by Bottenberg and Ward for testing treatment effects obtained in the presence of possible bias variables.[5] This type of analysis was used to examine both the effects and interactions of treatments and the bias variables--sex, intelligence, mental age, chronological age, socio-economic status, and auditory acuity--on criteria scores for auditory discrimination, oral reading and silent reading. Regression models were used rather than a two-way analysis of variance because most of the bias variables were continuous rather than discrete. It was felt that using regression models would allow more precision of measurement and would not eliminate information by the grouping of continuous data. In order to use regression models, the assumption was made that IQ, mental age, chronological age, and socio-economic status were on equal interval scales and hence, linear.

Multiple linear regression models were constructed with pretest scores included as a covariate to control pretest performance. As suggested by Bottenberg and Ward, models were first constructed to test for interactions of treatments and bias variables. These models sought

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[5]R. A. Bottenberg and J. E. Ward, Applied Multiple Linear Regression (Texas: Medical Division Air Force System Command, Aerospace, 1963), Chapter V.

to determine whether the amount of change in criterion per unit of change in bias variable was the same for both treatments. If the amounts were the same (no interaction), a test to determine whether the two treatments were equally effective over the observed range of the bias variable was made. This was the test for the effect of the treatments on criteria scores. If interaction was found, an estimate of the point of equal treatment effects was made. A detailed description of the regression models used in the present investigation is included in Appendix C.

The multiple linear regression program also provided correlations, means, and standard deviations for all the variables in its output.

VI. SUMMARY

Subjects for the experimental study were sixty first graders from two Edmonton Public Schools. There was little difference between schools or classrooms in chronological age, intelligence quotients, or mental age, but considerable difference in ability to make auditory discriminations, auditory acuity, and socio-economic ratings.

Two types of auditory tests were given. Individual audiometric tests were administered to test auditory acuity. A revised word pairs test was developed to test auditory discrimination. The construction and administration of the Fast-Cosens Auditory Discrimination Test was described in Chapter IV. The Gray Oral Reading Tests, Forms A and B were used to test oral reading, and the Lee-Clark Reading Test, First Reader, Forms A and B were used to test silent reading. Intellectual ability and mental age was measured by the California Short-Form Test of Mental Maturity.

The design for the study involved a pretest-treatment-posttest comparison of subjects given training in auditory discrimination with those not given such training.

Treatment involved a four week training period during which the experimental group received word pairs exercises and the control group listened to recorded stories presented at a listening center.

Data was processed with t-tests and multiple linear regression models.

CHAPTER VI

ANALYSIS OF DATA AND INTERPRETATION OF RESULTS

This chapter will examine the data obtained from the testing program carried out both prior to, and following the training program in auditory discrimination. First, an analysis will be made of the performance of the total test population on the Fast-Cosens Auditory Discrimination Test. The main purpose of this analysis will be to determine which types of sounds are difficult for grade one students to discriminate. Following this, an analysis of the effect of treatments on both reading achievement and auditory discrimination will be carried out. The influence of bias variables on auditory discrimination training will also be considered in this discussion.

I. PERFORMANCE OF THE TOTAL TEST POPULATION ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

The Fast-Cosens Auditory Discrimination Test was administered to the total test population of 117 subjects. Their performance on this test will be discussed in the following sections. First, the distribution of total auditory discrimination test scores will be outlined. Next, the Fast-Cosens Auditory Discrimination Test scores will be considered in terms of pupil scores for the specific sound types included. Sound types will be ranked according to their relative difficulty from an analysis of t-test results. Specific sounds in the sound types will then be considered and their relative difficulty discussed. Finally, the relationship between the bias variables--sex, socio-economic status, and chronological age--and performance on the

auditory discrimination test will be examined with the aid of t-test results.

Distribution of Total Scores on the Auditory Discrimination Test

There was considerable range in performance on the Fast-Cosens Auditory Discrimination Test with correct responses from 154 to 257. The total number possible was 266. The distribution of scores was somewhat skewed as can be seen in Figure 5. The mean was 222.56 and

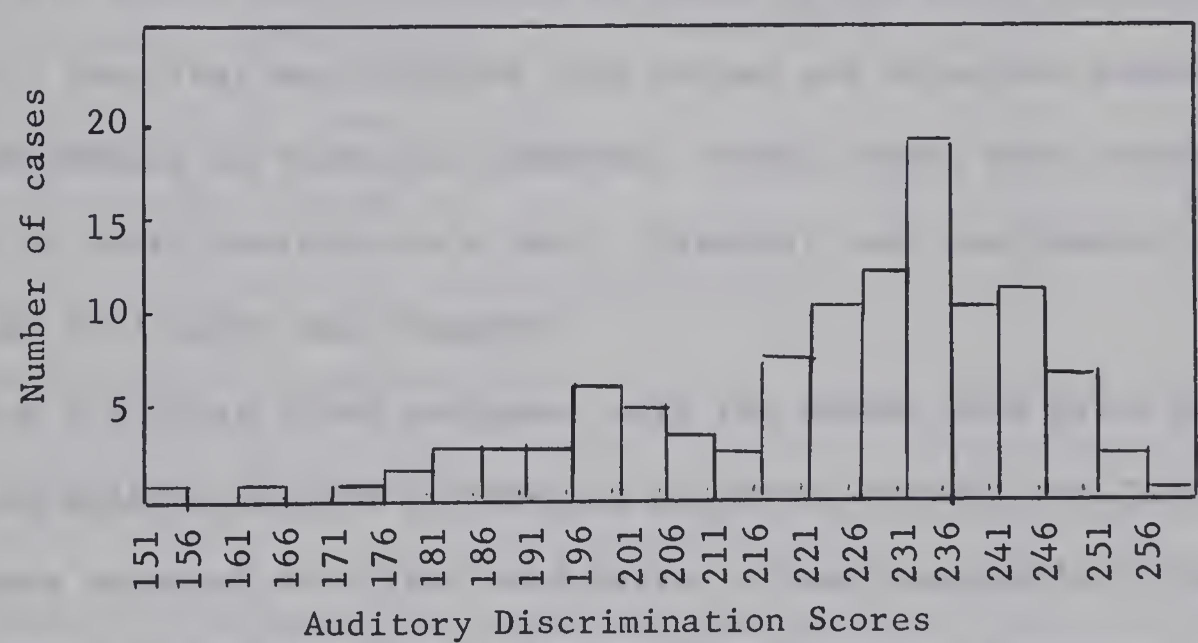

FIGURE 5

PERFORMANCE OF THE TOTAL TEST POPULATION ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

the standard deviation was 21.05.

This distribution of scores on the total auditory discrimination test suggests that performance was at a fairly high level. It must be remembered, however, that since this auditory discrimination test involved a two choice response for each item, subjects could get half of the items correct and score 133 on a chance basis alone. This was precisely the reason that three items for each like and each unlike word pair were included. In the discussion which follows, pupil performance

on all three test items is considered rather than simply number of items correct. A sound contrast was considered mastered only when a subject responded correctly to all three representative pairs. This cut down the influence of chance on the results.

Performance of the Total Test Population on Specific Sound Types

The Fast-Cosens Auditory Discrimination Test scores were analysed in several ways to examine ability to discriminate specific types of sounds. All sounds were considered in terms of the sound contrasts involved. Then they were divided into voiced and voiceless sounds and pupil performance on these was compared. Next, sounds were considered in terms of their position in a word. Finally, test performance on like and unlike word pairs was compared.

For the first three analyses, only the unlike word pairs and hence, the ability to hear differences of speech sounds, were involved. When errors occurred with like word pairs, it was impossible to know which phoneme in the like pair triggered the incorrect response. Hence, like word pairs could not be classified according to sound types.

Mean test scores on sound contrasts in unlike pairs could not be directly compared because the number of sounds in different sound types was not equal. Hence, the mean number of correct responses in each type of sound was changed to a common denominator of one with the result that comparisons were among mean proportions of correct test items. The differences among these mean proportions were assessed by a correlated t-test program.

Sound Contrasts. Performance on the 133 unlike word pairs indicated that some contrasts were definitely more difficult than others

for grade one subjects in the total test population. Table XV presents the mean proportion of each sound contrast mastered by the total test group.

TABLE XV

MEANS AND STANDARD DEVIATIONS OF THE TOTAL TEST POPULATION ON TEST SCORES GROUPED ACCORDING TO SOUND CONTRASTS

Sound Contrast	Mean	Standard Deviation
Stops (stop-stop comparisons)	.373	.253
Nasals (nasal-nasal comparisons)	.389	.302
Semivowel-lateral comparisons	.613	.326
Fricatives (fricative-fricative comparisons)	.566	.227
Affricate-fricative comparisons	.590	.282
Stop-fricative comparisons	.536	.256

Table XV indicates that stops were the most difficult sound contrasts to discriminate. The results of t-tests revealed that the mean score on stops was significantly lower than the mean score on all other sound contrasts except nasals (Table XVI). Nasals were the second most difficult sound type. Mean score on nasals was significantly lower than all other sound contrasts except stops. Stop-fricative comparisons were the third most difficult sound type. They were significantly more difficult than semivowel-lateral comparisons and affricate-fricative comparisons. Semivowel-lateral comparisons appeared to be the easiest sound contrasts for grade one subjects to discriminate. Subjects performed significantly better on semivowel-lateral comparisons than on stops, nasals, and stop-fricative comparisons. Since there were

TABLE XVI

T-TEST RESULTS OF COMPARISONS BETWEEN MEAN SCORES ON DIFFERENT SOUND CONTRASTS

	Nasals	Semivowel-lateral comparisons	Fricatives	Affricate-fricative comparisons	Stop-fricative comparisons
Stops	-0.685	-8.515**	-10.233**	-9.402**	-8.132**
Nasals		-7.342**	-7.532**	-7.498**	-5.749**
Semivowel-lateral comparisons			1.906	0.844	3.139**
Fricatives				-1.470	1.967
Affricate-fricative comparisons					2.416*

*Significant at the .05 level of confidence = 1.984

**Significant at the .01 level of confidence = 2.626

significant differences in the difficulty of sound contrasts, Hypothesis Two a) was rejected.

Templin found that the ability to articulate speech sounds developed in a somewhat different order. She found that the earliest sounds to be articulated correctly were nasals, semivowels, and stops. Fricatives and affricates were mastered later.[1] The present study found that even by age six and seven comparisons among stops and among nasals were difficult to discriminate. These results appear to be opposite to the expectations of Olmstead who postulated that a child's learning of phonology is a function of the ease of perception of phonemes.[2] Stops and nasals appeared to be articulated correctly but not discriminated accurately at age seven. It may not be accurate, however, to make a direct comparison between the findings of Templin and the present study. In the construction of the Fast-Cosens Auditory Discrimination Test, only the difficult aspects of stops and nasals as indicated by Templin's study were retained. The final results may have been closer to those found by Templin if both the easy and difficult comparisons among stops and among nasals had been retained in the research instrument.

Voiced and Voiceless Sounds. Sounds were contrasted according to whether they were voiced or voiceless and pupil performance on the two sound types was compared. The results of this comparison are shown in

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[1] M. C. Templin, Certain Language Skills in Children (Minneapolis: The University of Minnesota Press, 1957), p. 47.

[2] D. L. Olmstead, "A Theory of the Child's Learning of Phonology," Language, 42:531, 1966.

Table XVII. When all sound contrasts were considered, subjects performed significantly better on voiceless than on voiced sounds. A comparison of pupil performance on voiced and voiceless sounds within sound contrasts, however, produced less definitive results. Subjects performed significantly better on voiceless than on voiced stops and significantly better on voiceless than on voiced fricatives. Subjects performed slightly better on voiceless than on voiced affricate-fricative comparisons, and slightly better on voiceless than on voiced fricative-stop comparisons. These differences, however, were not significant.

These results are somewhat different than those of Templin who found that there was no significant difference between ability to articulate voiced and voiceless sounds when all sounds were considered. She did find, however, that voiceless fricatives could be articulated significantly better than voiced fricatives at most age levels.[3]

It is difficult to explain why voiceless sounds were easier to discriminate than voiced sounds. They are generally low intensity sounds of high frequency so one would not expect them to be easily discriminated. One confusing factor may be the formant transitions which follow voiced sounds (Chapter III). It may take children considerable time to master these and use them to help discriminate sounds.

Since subjects performed significantly better on the discrimination of voiceless as compared to voiced sounds, Hypothesis Two b) was rejected.

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[3]Templin, op. cit., pp. 49-50.

TABLE XVII

MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS OF COMPARISONS BETWEEN VOICED AND VOICELESS SOUNDS

Sound Contrasts	VOICED		VOICELESS		"t"
	Mean	Standard Deviation	Mean	Standard deviation	
Total	.482	.229	.556	.221	6.080**
Stops	.313	.290	.409	.281	3.832**
Fricatives	.458	.256	.608	.243	7.611**
Affricate-fricative comparisons	.558	.326	.613	.323	1.821
Fricative-stop comparisons	.520	.302	.561	.285	1.401

*Significant at the .05 level of confidence = 1.984

**Significant at the .01 level of confidence = 2.626

Initial, Medial, and Final Positions. Templin found in her study of articulation that sounds in the final position were the most difficult to articulate. Sounds in the medial position were second most difficult to articulate and sounds in the initial position were easiest.[4] The means, standard deviations, and t-test results for sounds in each position in this study are shown in Table XVIII.

TABLE XVIII

MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS OF COMPARISONS AMONG SOUNDS IN INITIAL, MEDIAL, AND FINAL POSITIONS

Position of sound in word	INITIAL		MEDIAL		FINAL		
Pupil performance	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	"t"
	.526	.233	.590	.240			4.176**
			.590	.240	.470	.225	10.002**
	.526	.233			.470	.225	3.946**

*Significant at the .05 level of confidence = 1.984

**Significant at the .01 level of confidence = 2.626

Table XVIII indicates that final sounds were the most difficult, and sounds in the medial position were the easiest to discriminate. Differences between mean scores in each position were significant at the .01 level of confidence. Hence, Hypothesis Two c) was rejected. The results of this study agree with those of Templin that the final position is the most difficult but the two studies disagree on the relative

[4] Ibid., p. 44.

difficulty of the intital and medial positions.

Sounds in the final position of words may have been more difficult to discriminate than sounds in the medial and initial position because of the absence of formant transitions. Liberman feels that formant transitions serve as important clues to distinguish stops, nasals, and semivowels. The final sound in a word would not be followed by a vowel and hence, would not provide a formant transition clue.

The fact that sounds in the final position were more difficult than sounds in other positions for the subjects in this study has implications for the order of difficulty found with sound contrasts. Most comparisons of stops and of nasals were in the final position. Hence, they may have been difficult partly because they were in the most difficult position to discriminate.

Like and Unlike Word Pairs. The mean number of errors made on like pairs was 11.02 and the mean number of errors on unlike pairs was 32.45. The difference between means was significant at the .01 level of confidence which led to the rejection of Hypothesis Two d). Apparently subjects in this sample found that hearing similarities of speech sounds in words was an easier discriminatory task than hearing differences. This may, however, be an oversimplification of the actual situation because attention probably influenced the results.

Although the Fast-Cosens Auditory Discrimination Test was administered in two fifteen minute sessions, this was apparently somewhat long for some subjects with short attention spans. The typical reaction of such subjects was to occasionally sit without moving for

several trials until a break was given. Since the correct response for like pairs was keeping the hand down, these subjects would be credited with correct responses on like pairs and incorrect responses on unlike pairs during the period they were not attending.

However, the effects of inattention were partially eliminated by frequent breaks so that it is probably correct to conclude that the subjects in this study were able to hear similarities in speech sounds better than differences. The magnitude of the differences between scores on like and unlike pairs, however, may not reflect an actual difference in ability to make discriminations.

The relative ease of hearing similarities as compared to differences is in accordance with the sequence of steps in perception outlined by Vernon. The steps involved awareness, abstracting similarities for classification, perceiving differentia, and identification.[5] Perceiving differentia is a more advanced process than abstracting similarities and is dependent on both awareness and a pupil's ability to abstract similarities. Hence, hearing differences would probably be a more difficult perceptual task and would probably develop later than the ability to hear similarities.

Summary. Analysis of the test scores of the total test population indicated that stops were the most difficult sounds to discriminate, that nasals were the second most difficult, and that fricative-stop comparisons were the third in difficulty. Semivowel-lateral comparisons, fricatives, and affricate-fricative comparisons

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[5] M. D. Vernon, A Further Study of Visual Perception (Cambridge: University Press, 1952), p. 25.

were all easier to discriminate than the first three. Voiced sounds were more difficult than voiceless sounds. Sounds in the final position were more difficult to discriminate than sounds in the initial position. Sounds in the medial position were easiest to discriminate. Similarities of speech sounds in words were easier to discriminate than differences.

Performance of the Total Test Population on Specific Sound Contrasts

Although it is important to get at general types of difficulties pupils have recognizing differences between sounds, it is also important to determine which specific sounds within types are the most difficult, and to try and determine why. It is deceptive, for instance, to note that the total test population was significantly better on fricatives than several other sounds for the single most difficult sound contrast was in this sound type. Table XIX presents the per cent of the total test population mastering each sound contrast in each position. It also presents the per cent of the top 40th percentile and the bottom 60th percentile mastering each sound. Mastery was again defined as correctly responding to all three instances of a single contrast.

A close examination of the sound contrasts which 30 per cent or less of the total test population were able to discriminate correctly suggested that sounds articulated near the front of the mouth presented a problem (Table XX). Children probably relied on visual clues to aid reception of these sounds. With visual clues removed, performance was at a fairly low level.

Many of the difficult contrasts were in the final position of the word pairs and most were voiced. This would be expected since both final position of sounds and voiced sounds were difficult according to

TABLE XIX

PER CENT OF THE TOTAL AND SUB GROUPS THAT MASTERED EACH SOUND CONTRAST IN EACH POSITION

Sound contrast		Total	Top 40th percentile	Bottom 60th percentile
STOPS				
voiceless	-pt-	60.48%	91.14%	41.10%
	-pt	47.04%	56.42%	41.10%
	-pk	15.96%	30.44%	6.85%
	-tk-	33.60%	58.59%	17.81%
	-tk	44.52%	62.93%	32.88%
voiced	-dg	13.42%	26.14%	5.48%
	-db	56.28%	86.80%	36.99%
	-gb	24.36%	45.57%	10.96%
NASALS				
	-nŋ-	35.28%	52.08%	24.66%
	-nŋ	28.56%	41.23%	20.55%
	-mŋ-	53.76%	78.12%	38.36%
	-mŋ	37.80%	58.59%	24.66%
SEMIVOWEL-LATERAL COMPARISONS				
	lr-	65.52%	88.97%	50.69%
	-lr-	62.16%	78.12%	52.06%
	wl-	56.28%	78.12%	42.47%
	wr-	61.32%	80.29%	49.32%
FRICATIVES				
voiceless	θf-	9.24%	8.68%	9.59%
	θs-	62.16%	84.63%	47.95%
	-Os	55.44%	82.46%	38.36%
	-sf-	74.76%	95.48%	61.65%
	-sf	59.64%	82.46%	45.21%
	šs-	68.04%	82.46%	58.91%
	-šs-	77.28%	91.14%	68.50%
	-šs	39.48%	56.42%	28.77%
	šθ-	57.12%	84.63%	39.73%
	-šθ	75.60%	91.14%	65.76%
	-šf-	76.44%	97.65%	63.02%
	-šf	74.76%	91.14%	64.39%
voiced	vð-	29.94%	43.40%	21.92%
	-vð	11.96%	15.19%	9.59%
	-zð-	47.04%	69.44%	32.88%
	-vz-	73.08%	75.95%	71.24%
	-vz	67.20%	97.65%	47.95%

TABLE XIX (continued)

PER CENT OF THE TOTAL AND SUB GROUPS THAT MASTERED EACH SOUND CONTRAST IN EACH POSITION

Sound contrast		Total	Top 40th percentile	Bottom 60th percentile
AFFRICATE-FRICATIVE COMPARISONS				
voiceless	šč-	54.60%	67.27%	46.58%
	-šč-	58.80%	71.61%	50.69%
	-šč	68.04%	82.46%	58.91%
voiced	-ǰz-	74.76%	93.31%	63.02%
	-ǰz	54.60%	84.63%	35.62%
	-ǰž-	38.64%	56.42%	27.40%
FRICATIVE-STOP COMPARISONS				
voiceless	-pf	67.20%	82.46%	57.54%
	pθ-	74.76%	88.97%	65.76%
	-pθ	24.36%	41.23%	13.70%
voiced	vb-	20.16%	17.36%	21.92%
	ð̌b-	51.24%	82.46%	31.51%
	-zd	68.04%	88.97%	54.80%
	dð̌-	69.72%	88.97%	57.54%
	-dð̌	57.96%	78.12%	45.21%

TABLE XX

SPECIFIC SOUND CONTRASTS MASTERED BY 30 PER CENT AND LESS OF THE TOTAL POPULATION IN ORDER OF DIFFICULTY

Sound Contrast	Word Pairs	Percent of Group Mastering Sound	Place of Articulation
fθ-	first thirst	76.5%	Front
	fought thought	53.8%	
	fence thence	15.1%	
-vð	clove clothe	32.8%	Front
	lathe lave	35.3%	
-dg	bad bag	17.6%	Center and Back
	big bid	82.4%	
	led leg	79.8%	
-pk	peak peep	65.5%	Front and Back
	coke cope	49.6%	
	shape shake	31.1%	
vb-	volt bolt	36.1%	Front
	ban van	73.9%	
	bail vail	63.9%	
-pθ	rap wrath	58.8%	Front
	sheep sheath	46.2%	
	wreath reap	73.1%	
-gb	rub rug	52.9%	Front and Back
	cog cob	44.5%	
	tug tub	64.7%	
-nŋ	ran rang	80.7%	Center and Back
	sun sung	33.6%	
	win wing	80.7%	
vð-	thine vine	52.9%	Front
	thy vie	61.3%	
	vow thou	77.3%	

t-test results.

The sound contrasts for which only one word pair presented a problem may suggest one of two possibilities. First, the particular vowel before or following the consonant of interest may have affected discrimination. However, there did not appear to be a pattern of difficulty revolving around the type or position of the vowel near the consonant. The influence of formant transitions on ease of discrimination did not differ for front, back, or center vowels. The second possibility is that the articulation of some pairs on the tape may not have been quite as good as others. This second possibility was suggested by the comparisons such as -dg where two of the word pairs were relatively easy and one was very difficult, and there was no basic difference in the type of vowel following the consonant. At any rate, poor performance on -dg and -nŋ comparisons may not represent general deficiencies but simply reflect difficulty with particular sounds in particular contexts. Most of the other sounds in Table XX are difficult regardless of the specific context involved.

<u>Effect of Sex, Age and Socio-Economic Status on Ability to Make Auditory Discriminations</u>

Studies were cited in Chapter III which found sex, age, and socio-economic status significantly related to auditory discrimination. In order to assess the effect of each of these variables on the auditory discrimination scores of the total test population, t-tests were undertaken to determine the significance of differences between mean scores of groups differentiated by sex, age, and socio-economic status. The results of these t-tests are discussed in the following sections.

Sex. Several studies have indicated that boys do not mature as quickly as girls in the auditory realm. Reid's study indicated that a significant difference between boys and girls was evident only at the beginning of the grade one year. Others such as Wepman, however, feel that the difference extends beyond the grade one year. Hence, the results of the present study were expected to show either that girls were superior to boys, or that there was no difference between boys and girls. The results of the t-tests, however, do not support these expectations.

Table XXI indicates that the boys performed slightly better than the girls on total auditory discrimination and on auditory discrimination of sound types. The differences between mean scores for boys and girls were significant only on like word pairs. Hence, Hypothesis Three a) was accepted although boys were significantly better than girls on ability to discriminate sounds in like pairs at the .01 level of confidence.

Chronological Age. Differences between mean scores due to chronological age were generally greater than those due to sex. As Table XXII indicates, many of the differences between old and young subjects on total auditory discrimination and sound types approached significance. Young subjects ranged from seventy-six to eighty-two months and old subjects ranged from eighty-two and one-half to ninety-one months.

The older subjects were somewhat superior to the younger subjects on total auditory discrimination scores and on all the sound types except like word pairs. The differences between the two age groups

TABLE XXI

MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS FOR BOYS AND GIRLS ON TOTAL AUDITORY DISCRIMINATION AND SOUND TYPES

Scores	BOYS		GIRLS		"t"
	Mean	Standard Deviation	Mean	Standard Deviation	
Total	222.38	17.94	219.60	23.53	1.488
Stops	3.22	1.91	2.74	2.12	1.279
Nasals	1.60	1.23	1.51	1.19	0.405
Semivowel-lateral comparisons	2.52	1.31	2.39	1.29	0.538
Fricatives	9.63	3.62	9.60	4.11	0.051
Affricate-fricative comparisons	3.55	1.73	3.53	1.66	0.075
Fricative-stop comparisons	4.43	1.99	4.14	2.10	0.768
Voiced sounds	11.65	5.38	11.49	5.61	0.155
Voiceless sounds	13.22	4.74	12.33	5.38	0.936
Initial sounds	6.97	2.77	6.70	3.26	0.470
Medial sounds	7.68	3.02	7.67	3.21	0.029
Final sounds	10.25	4.61	9.47	4.81	0.885
Like pairs	9.24	5.90	12.67	7.03	-2.663**
Unlike pairs	31.37	17.69	33.60	21.32	-0.612

*Significant at the .05 level of confidence = 1.984

**Significant at the .01 level of confidence = 2.626

TABLE XXII

MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS FOR GROUPS ACCORDING TO AGE ON TOTAL AUDITORY DISCRIMINATION AND SOUND TYPES

	OLD		YOUNG		
Scores	Mean	Standard Deviation	Mean	Standard Deviation	"t"
Total	225.13	19.82	219.86	21.95	1.353
Stops	3.12	2.01	2.84	2.02	0.728
Nasals	1.77	1.27	1.33	1.10	1.954
Semivowel-lateral comparisons	2.70	1.23	2.19	1.33	2.124*
Fricatives	10.02	3.75	9.19	3.93	1.148
Affricate-fricative comparisons	3.80	1.60	3.26	1.74	1.722
Fricative-stop comparisons	4.50	1.92	4.07	2.16	1.130
Voiced sounds	12.50	5.23	10.60	5.60	1.885
Voiceless sounds	13.40	4.78	12.14	5.30	1.340
Initial sounds	7.45	2.81	6.19	3.10	2.278*
Medial sounds	8.08	2.95	7.25	3.22	1.454
Final sounds	10.38	4.46	9.33	4.92	1.200
Like pairs	11.67	6.81	10.33	6.45	1.077
Unlike pairs	29.17	16.36	35.91	21.94	-1.875

*Significant at the .05 level of confidence = 1.984

**Significant at the .01 level of confidence = 2.626

were significant for semivowel-lateral comparisons and for sounds in the initial position. However, since most differences were not significant, Hypothesis Three b) was accepted.

The lateral and semivowel /r/ have been found to be mastered at a fairly late age in articulation studies. Poole, for example, found that 75 per cent of his sample could not correctly articulate the lateral until age 6.5 and the semivowel /r/ until age 7.5.[6] It appears that difficulties in articulating /r/ and /l/ are accompanied by parallel difficulties with discrimination.

Initial sounds were found by Templin to be mastered earlier than sounds in the other positions.[7] Hence, it is surprising that the young subjects in the present study performed significantly lower than the old subjects on discriminating initial sounds since one would expect them to be mastered fairly early. Although few differences between age groups were significant, there is some indication that auditory discrimination is a developmental process. The differences may have reached significance if the range of ages in the test sample had been greater.

Socio-Economic Status. The t-tests for socio-economic status revealed that subjects of high socio-economic status did not do significantly better than those of low socio-economic status on any measure of auditory discrimination. Hence, Hypothesis Three c) was accepted although mean scores were generally slightly higher for

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[6] *Ibid.*, p. 53.

[7] *Ibid.*, p. 44.

subjects of high socio-economic status than those of low socio-economic status (Table XXIII).

Several factors may have prevented socio-economic status from being a significant factor in the present study. Both schools were from middle socio-economic areas as defined by school officials. Hence, none of the subjects in the sample fell into Blishen's lowest class level. Few were lower than class five. Hence, there may not have been enough difference in socio-economic status between the high group with subjects from classes one to three and the low group with subjects from classes four to six to produce significant results.

Summary. Boys were slightly superior to girls on total auditory discrimination scores and on the auditory discrimination of all sound types, but the differences were significant only on like word pairs. Older subjects were slightly superior to younger subjects on total auditory discrimination and on the discrimination of most sound types. Differences between old and young subjects were significant on lateral-semivowel comparisons and on sounds in the initial position. There were no significant differences between the scores of subjects from high socio-economic status and subjects of low socio-economic status although the high socio-economic group scored slightly higher than the low socio-economic group.

A summary of information concerning the difficulty of making auditory discriminations according to the characteristics of pupils and sound types is presented in Table XXIV.

TABLE XXIII

MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS FOR GROUPS ACCORDING TO SOCIO-ECONOMIC STATUS ON TOTAL AUDITORY DISCRIMINATION AND SOUND TYPES

Scores	HIGH		LOW		"t"
	Mean	Standard Deviation	Mean	Standard Deviation	
Total	224.88	17.59	221.21	22.89	0.894
Stops	3.27	1.87	2.78	2.11	1.266
Nasals	1.72	1.16	1.37	1.20	1.520
Semivowel-lateral comparisons	2.62	1.28	2.31	1.24	1.248
Fricatives	9.83	3.50	9.65	4.01	0.259
Affricate-fricative comparisons	3.82	1.55	3.29	1.70	1.678
Fricative-stop comparisons	4.23	1.90	4.47	2.03	-0.629
Voiced sounds	12.17	5.06	11.14	5.52	1.015
Voiceless sounds	13.28	4.38	12.61	5.28	0.730
Initial sounds	7.05	2.52	6.84	3.23	0.376
Medial sounds	8.25	2.77	7.18	3.20	1.877
Final sounds	10.13	4.48	9.80	4.59	0.378
Like pairs	11.02	6.19	11.27	7.29	-0.200
Unlike pairs	30.17	17.06	33.25	19.44	-0.883

*Significant at the .05 level of confidence = 1.984

**Significant at the .01 level of confidence = 2.626

TABLE XXIV

SUMMARY OF INFORMATION CONCERNING THE DIFFICULTY OF MAKING AUDITORY DISCRIMINATIONS ACCORDING TO THE CHARACTERISTICS OF PUPILS AND CHARACTERISTICS OF SOUND TYPES

Characteristic of pupil or of sound type	Difficulty	Hypothesis Accepted	Hypothesis Rejected
Sex	Boys scores slightly better than girls on all sound types but the difference was significant only on like pairs.	3a	
Chronological Age	Older subjects were slightly better than younger subjects on most sound types but the difference was significant only on semivowel-lateral comparisons, and initial sounds.	3b	
Socio-Economic Status	High socio-economic groups scored slightly better on all sound types but the differences were not significant.	3c	
Sound Contrasts	1. stops; 2. nasals; 3. stop-fricative comparisons; 4. affricate-fricative comparisons, semivowel-lateral comparisons, and fricatives.*		2a
Voicing	1. voiced sounds; 2. voiceless sounds.*		2b
Position	1. final; 2. initial; 3. final.*		2c
Word Pairs	1. unlike word pairs; 2. like word pairs.*		2d

*These are listed with the most difficult sound type listed first.

II. EFFECT OF TREATMENTS ON READING ACHIEVEMENT AND AUDITORY DISCRIMINATION SCORES

The main purpose of the present study was to investigate the effect of taped training in auditory discrimination on the reading achievement and on the auditory discrimination of grade one pupils. The following section will present the findings related to this purpose. The pretest and posttest performance of the test sample on the auditory discrimination and reading tests will be described. The effects and interactions of treatments and the bias variables--intelligence quotient, mental age, chronological age, sex, socio-economic status, and auditory acuity--on reading achievement and auditory discrimination scores will then be discussed.

Performance of the Test Sample on the Oral Reading Tests

The Gray Oral Reading Tests, Form A, was administered during the third week of May to obtain oral reading pretest scores for the experimental and control groups. The distribution of raw scores on this test is shown in Figure 6. The mean score for the total sample was 12.25 and the standard deviation was 6.57.

There was very little difference between the control and experimental groups on pretest performance. The mean score of the experimental group was 12.1 and the mean score of the control group was 12.3.

A posttest oral reading score was obtained from the administration of the Gray Oral Reading Tests, Form B, during the third week of June. Performance on Form B is shown in Figure 7 which indicates that there was slight overall improvement in oral reading between the pretest and

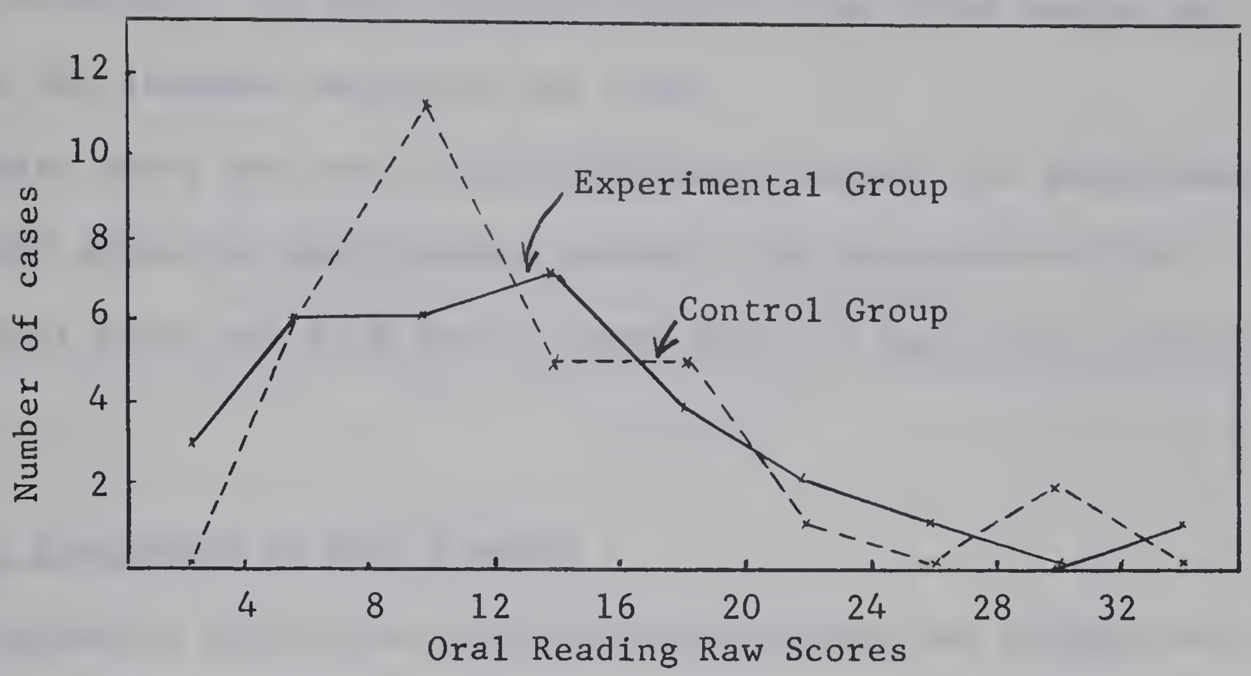

FIGURE 6

ORAL READING PRETEST SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS

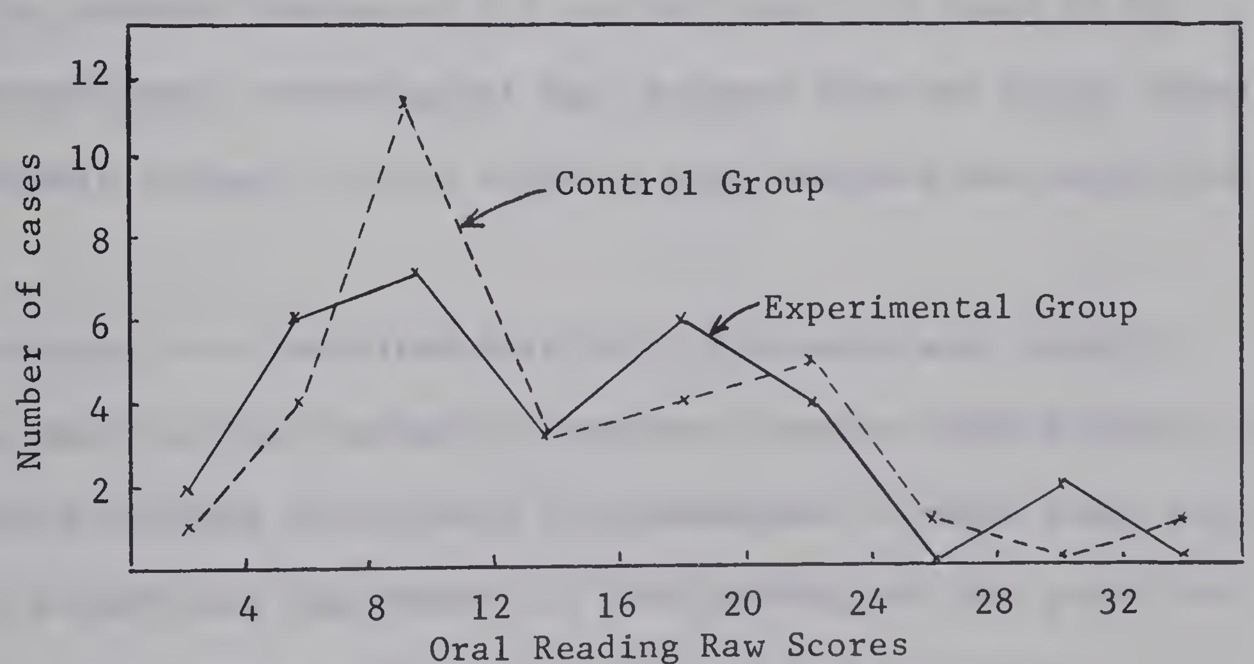

FIGURE 7

ORAL READING POSTTEST SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS

posttest sessions. The mean posttest score of the total sample was 13.25 and the standard deviation was 7.38.

Again there was very little difference between the experimental and control groups on oral reading scores. The mean score of the experimental group was 13.2 and the mean score of the control group was 13.3.

Effect of Treatments on Oral Reading

Regression models were constructed to assess the effects and interactions of treatments and the bias variables--IQ, mental age, chronological age, sex, socio-economic status, and auditory acuity--on oral reading scores.

The interactions of treatments and the bias variables on oral reading were not found to be significant (Table XXV). Hence, the differences between treatments did not vary over the range of IQ scores, mental age, chronological age, between boys and girls, among socio-economic ratings, or for subjects with adequate and borderline acuity.

F-ratios also indicated that both treatments were equally effective when the bias variables were held constant (Table XXV). Hence, taped training in auditory discrimination for four weeks did not bring significant improvement in oral reading for the grade one subjects in this sample and Hypothesis One c) was accepted.

Performance of the Sample on Silent Reading Tests

Silent reading achievement was assessed on the Lee-Clark Reading Test, First Reader. Form A was administered during the third week in May to provide pretest scores. The performance of the experimental and

TABLE XXV

F-RATIOS FOR THE INTERACTIONS AND EFFECTS OF TREATMENTS AND THE BIAS VARIABLES ON ORAL READING ACHIEVEMENT

Bias Variable	Interaction F-Ratios	Treatment Effects F-Ratios
IQ: Total	0.2509	0.0855
IQ: Verbal (language)	-0.1077	0.2556
IQ: Non-Verbal (non-language)	0.6011	0.0258
Mental Age: Total	-0.1066	0.1153
Mental Age: Verbal (language)	0.0306	0.3022
Mental Age: Non-Verbal (non-language)	-0.0172	0.0372
Chronological Age	-0.1226	0.0002
Sex	3.3048	0.0147
Socio-Economic Status	0.0025	0.0240
Auditory Acuity	0.0044	0.0006

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

and control groups on this test is presented in Figure 8.

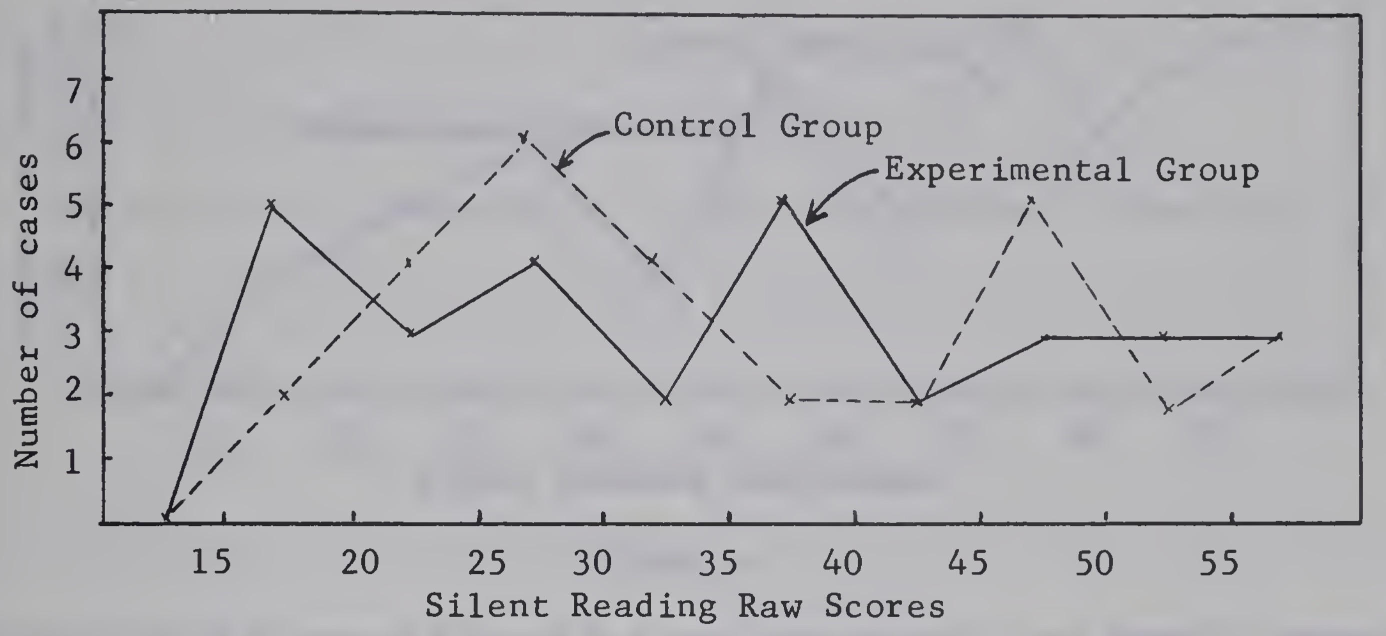

FIGURE 8

SILENT READING PRETEST SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS

The mean performance of the total sample on Form A was 35.53 and the standard deviation was 12.83. There was considerable variation in performance on this test. The mean pretest score of the experimental group was 35.6 and that of the control group was 35.4.

Both groups were administered the Lee-Clark Reading Test, Form B during the last week of June. The distribution of scores on this test is shown in Figure 9.

The mean score on Form B for the total sample was 39.97 and the standard deviation was 12.64. Again there was considerable variation in performance. The scores did indicate, however, a slightly improved level of performance. The mean posttest score of the experimental group was 39.9 and that of the control group was 40.0.

The silent reading test was divided into two sections. Parts

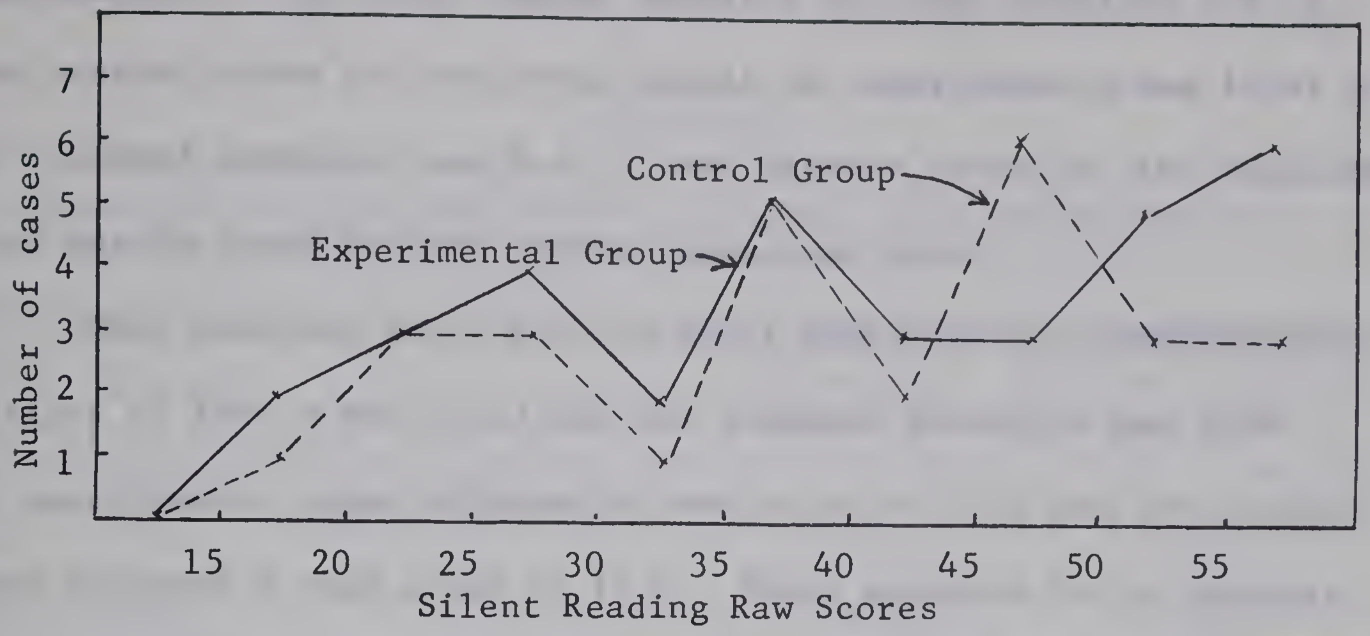

FIGURE 9

SILENT READING POSTTEST SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS

one and two measured word recognition. The mean score of the total sample on the word recognition sections of the Lee-Clark Reading Test, Form A was 21.12 and the standard deviation was 6.80. The total number possible on the word recognition sections was 30. The mean score of the experimental group on Form A was 21.3 and the mean score of the control group was 20.9.

The mean posttest score for the total sample on the word recognition sections of the Lee-Clark Reading Test, Form B was 22.63 and the standard deviation was 7.33. These scores indicate that there was slight improvement on word recognition for the total sample between testings. The mean posttest score for the experimental group was 22.3 and that for the control group was 22.9. Hence, the control group made slightly greater improvement than the experimental group on word recognition.

Parts three to five of the Lee-Clark Reading Test measured

comprehension. The total number possible on these sections was 29. Mean pretest score for the total sample on comprehension was 14.42 and the standard deviation was 6.83. Mean pretest score for the experimental group was 14.3 and for the control group was 14.5.

Mean posttest score for the total sample on the comprehension sections of Form B was 17.33 and the standard deviation was 6.09. The experimental group achieved a mean score of 17.6 and the control group achieved a mean score of 17.1. There appeared to be slightly more improvement for the experimental group than for the control group on comprehension.

Considering the total sample, there was more improvement between testings on comprehension than on word recognition. On both testings, however, subjects performed better on the word recognition than on the comprehension sections.

<u>Effect of Treatments on Silent Reading</u>

As indicated in Table XXVI, none of the interactions between treatments and the bias variables on total silent reading achievement were significant. In other words, the amount of change in silent reading achievement per unit of change in the bias variables was the same for both treatments. The F-ratios for treatment effects indicate that both treatments were equally effective when each of the bias variables was held constant. The experimental group was not significantly different than the control group on total silent reading achievement. Hence, the auditory training given in this study did not appear to improve total silent reading achievement and Hypothesis One d) was accepted.

TABLE XXVI

F-RATIOS FOR THE INTERACTIONS AND EFFECTS OF TREATMENTS AND THE BIAS VARIABLES ON TOTAL SILENT READING ACHIEVEMENT

Bias Variables	Interaction F-Ratios	Treatment Effects F-Ratios
IQ: Total	0.5733	0.0015
IQ: Verbal (language)	1.0452	0.0014
IQ: Non-Verbal (non-language)	0.2061	0.0076
Mental Age: Total	0.2448	0.0159
Mental Age: Verbal (language)	0.3179	0.0189
Mental Age: Non-Verbal (non-language)	0.1131	0.0145
Chronological Age	0.0144	0.0004
Sex	2.0850	0.0138
Socio-Economic Status	0.0404	0.0484
Auditory Acuity	0.4363	0.0344

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

Models to test the interactions of treatments and the bias variables on word recognition and comprehension indicated that there were no significant interactions of treatments with IQ, mental age, chronological age, socio-economic status, or auditory acuity. There was, however, a significant interaction between treatments and sex on word recognition at the .05 level of confidence. This indicates that the difference in effects of treatments varied for boys and girls. A consideration of the weights for the interaction vectors showed that the girls scored higher on word recognition than the boys in the experimental group. However, boys scored better than the girls on word recognition in the control group. It appears that auditory training was of more benefit to girls in improving word recognition scores than to boys (Table XXVII).

Tests for treatment effects were made for both word recognition and comprehension. These indicated that the experimental group was not significantly better than the control group on word recognition or comprehension scores when each of the bias variables was taken into account. Hence, auditory training for four weeks did not improve word recognition or comprehension.

Summary of the Effects of Treatments on Reading Achievement

The training in auditory discrimination given during the treatment period of this study did not appear to result in increased reading achievement. The experimental group did not make significantly higher posttest scores on oral reading, total silent reading, word recognition, or comprehension than the control group. Only the interaction between treatments and sex on word recognition was

TABLE XXVII

F-RATIOS FOR THE INTERACTIONS AND EFFECTS OF TREATMENTS AND THE BIAS VARIABLES ON WORD RECOGNITION AND COMPREHENSION SCORES

	INTERACTIONS		TREATMENT EFFECTS	
Bias Variables	Word Recognition	Comprehension	Word Recognition	Comprehension
Total IQ	0.7074	0.2243	1.1279	1.5635
Total Mental Age	0.3209	0.1366	0.9855	1.0267
Chronological Age	-0.1418	-0.0164	0.9559	1.1469
Sex	4.1435*	0.0351	0.9164	0.7651
Socio-economic Status	0.1836	0.9929	1.1748	0.6636
Auditory Acuity	0.0009	0.6609	0.9513	0.6394

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

significant. Girls apparently benefited more from the auditory training program than boys on word recognition scores in the time allotted.

Correlations between Reading and Auditory Discrimination Scores

Although auditory training for four weeks did not result in improved reading achievement, correlations suggest that there was a relationship between scores on auditory discrimination and reading tests. Table XXVIII presents the correlations between pretest auditory discrimination and all reading scores. Table XXIX presents the correlations between posttest auditory discrimination and all reading scores.

None of the pretest auditory discrimination scores and only two posttest scores were significantly related to oral reading achievement. The correlations between oral reading achievement and scores on fricatives and sounds in the initial position of words reached significance at the .05 level of confidence but were small.

There was a significant relationship between both pretest and posttest scores on auditory discrimination and total silent reading at the .01 level of confidence. Scores on several specific sound types were also significantly related to total silent reading achievement.

Total pretest and posttest auditory discrimination performance was also significantly related to word recognition and comprehension scores. There appeared to be a somewhat stronger relationship between posttest auditory discrimination scores and word recognition than posttest auditory discrimination scores and comprehension. Twenty-three of the correlations between word recognition and posttest auditory discrimination scores were significant. Only fifteen of the correlations between comprehension and posttest auditory discrimination

TABLE XXVIII

CORRELATIONS BETWEEN PRETEST AUDITORY DISCRIMINATION SCORES AND ORAL AND SILENT READING SCORES

Pretest Auditory Discrimination Scores	ORAL READING SCORES		SILENT READING SCORES Total		Word Recognition		Comprehension	
	pre test	post test	pre test	post test	pre test	post test	pre test	post test
Total	.252	.264	.426	.452	.458	.481	.342	.359
Stops	.181	.172	.284	.315	.269	.261	.264	.339
Nasals	.009	.021	.215	.142	.184	.138	.220	.127
Semivowel-lateral comparisons	.161	.220	.304	.256	.263	.262	.309	.216
Fricatives	.207	.240	.351	.369	.350	.383	.311	.304
Affricate-fricative comparisons	.039	.099	.214	.206	.201	.196	.201	.191
Fricative-stop comparisons	.229	.214	.313	.398	.314	.426	.274	.312
Voiced sounds	.219	.237	.397	.392	.366	.395	.381	.338
Voiceless sounds	.150	.186	.296	.325	.302	.324	.255	.285
Initial sounds	.206	.245	.388	.373	.365	.395	.364	.299
Medial sounds	.154	.175	.329	.275	.290	.257	.328	.260
Final sounds	.183	.202	.316	.394	.327	.393	.267	.345
Like pairs	-.030	.013	-.021	-.071	-.063	-.101	.023	-.025
Unlike pairs	-.221	-.250	-.402	-.405	-.424	-.427	-.333	-.327

—Significant at the .05 level of confidence = .273

—Significant at the .01 level of confidence = .354

TABLE XXIX

CORRELATIONS BETWEEN POSTTEST AUDITORY DISCRIMINATION SCORES AND ORAL AND SILENT READING SCORES

Posttest Auditory Discrimination Scores	ORAL READING SCORES		SILENT READING SCORES					
			Total		Word Recognition		Compre-hension	
	pre test	post test	pre test	post test	pre test	post test	pre test	post test
Total	.202	.215	.457	.437	.458	.455	.402	.358
Stops	-.125	-.041	.134	.149	.176	.231	.076	.030
Nasals	.091	.070	.234	.264	.270	.283	.171	.207
Semivowel-lateral comparisons	.057	.129	.321	.347	.370	.410	.234	.226
Fricatives	.143	.287	.457	.473	.440	.514	.419	.362
Affricate-fricative comparisons	.107	.112	.297	.260	.292	.309	.266	.167
Fricative-stop comparisons	.269	.227	.433	.437	.437	.480	.378	.328
Voiced sounds	.085	.135	.377	.374	.394	.438	.316	.249
Voiceless sounds	.154	.248	.440	.466	.449	.522	.379	.337
Initial sounds	.214	.346	.490	.500	.511	.540	.411	.387
Medial sounds	.109	.137	.347	.380	.340	.443	.313	.254
Final sounds	.046	.097	.339	.334	.356	.397	.281	.215
Like pairs	-.174	-.135	-.248	-.223	-.261	-.191	-.206	-.232
Unlike pairs	-.144	-.188	-.420	-.409	-.409	-.454	-.381	-.302

—Significant at the .05 level of confidence = .273

—Significant at the .01 level of confidence = .354

scores were significant. There was little difference, however, in the number of significant correlations between pretest auditory discrimination scores and comprehension and between pretest auditory discrimination scores and word recognition.

Although few of the correlations between auditory discrimination and silent reading scores were above .50, many were significant at the .01 level of confidence. Hence, there was at least a moderate relationship between auditory discrimination and silent reading achievement. Few of the correlations between auditory discrimination and oral reading scores, however, were significant. Apparently the ability to make auditory discriminations is more closely related to silent reading achievement than to oral reading achievement. This may result because the extra task of oral production required in oral reading interferes with accurate word recognition and comprehension.

Since there appeared to be a relationship between silent reading achievement and auditory discrimination, auditory training should have brought improvements in silent reading performance. Several factors may have prevented improved performance in the present study.

First, since auditory training was given near the end of the grade one year, subjects were probably not being given phonic training to which newly developed auditory discrimination skills could be applied. Most word attack skills had already been taught and considerable time was being devoted to review and testing during the training period.

The length of the training period probably limited the amount of transfer that could take place from auditory discrimination abilities to word attack skills. The length of the training period also may have

limited the effect of improved auditory discrimination on the development of word meanings for comprehension.

A final factor which may have decreased the effectiveness of auditory training on silent reading achievement was the time of posttesting. Silent reading posttests were administered during the final week of June. Many children were tired and anxious for the onset of holidays with the result that attention spans were frequently not as long as they normally would have been during the school year.

Performance of the Test Sample on the Auditory Discrimination Test

The test population was administered the Fast-Cosens Auditory Discrimination Test during the first two weeks in May, but only the test performance of the sixty subjects in the final sample is shown in Figure 10.

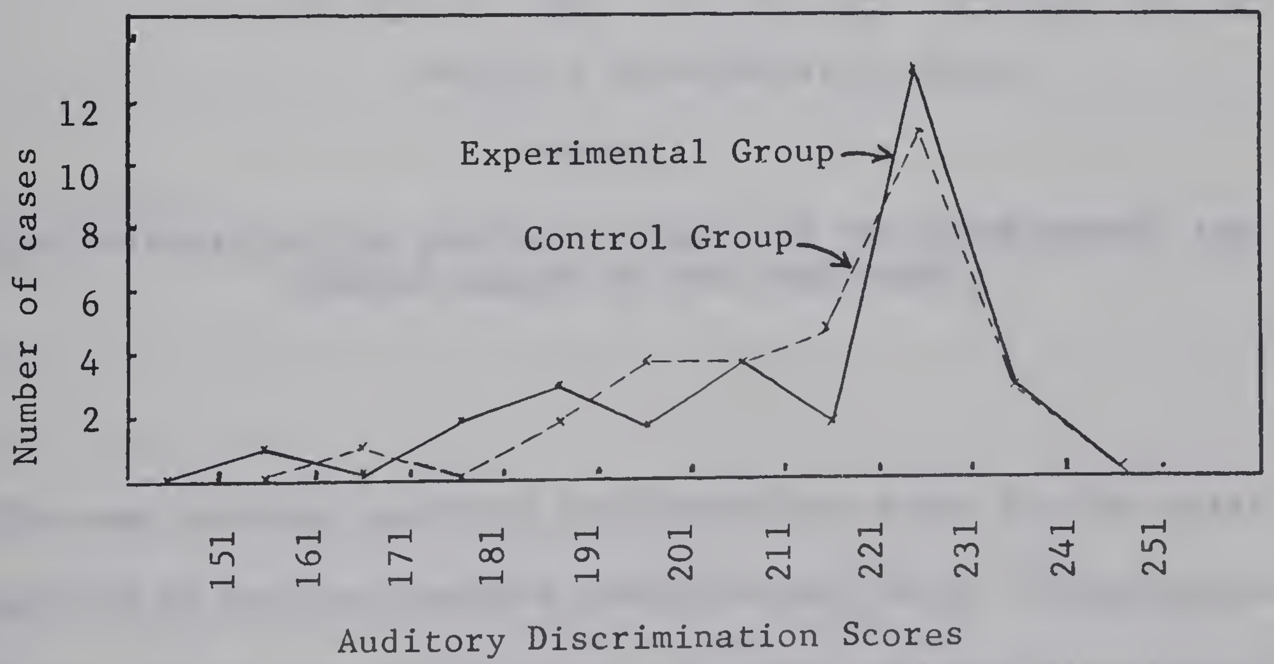

FIGURE 10

AUDITORY DISCRIMINATION PRETEST SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS OF TEST SAMPLE

The mean pretest score for the total test sample was 211.97 and the standard deviation was 19.19. The experimental group obtained a mean score of 208.7 and the control group obtained a mean score of 212.8.

The Fast-Cosens Auditory Discrimination Test was readministered during the third week of June to obtain posttest scores. The distribution of scores for the experimental and control groups on this testing is shown in Figure 11.

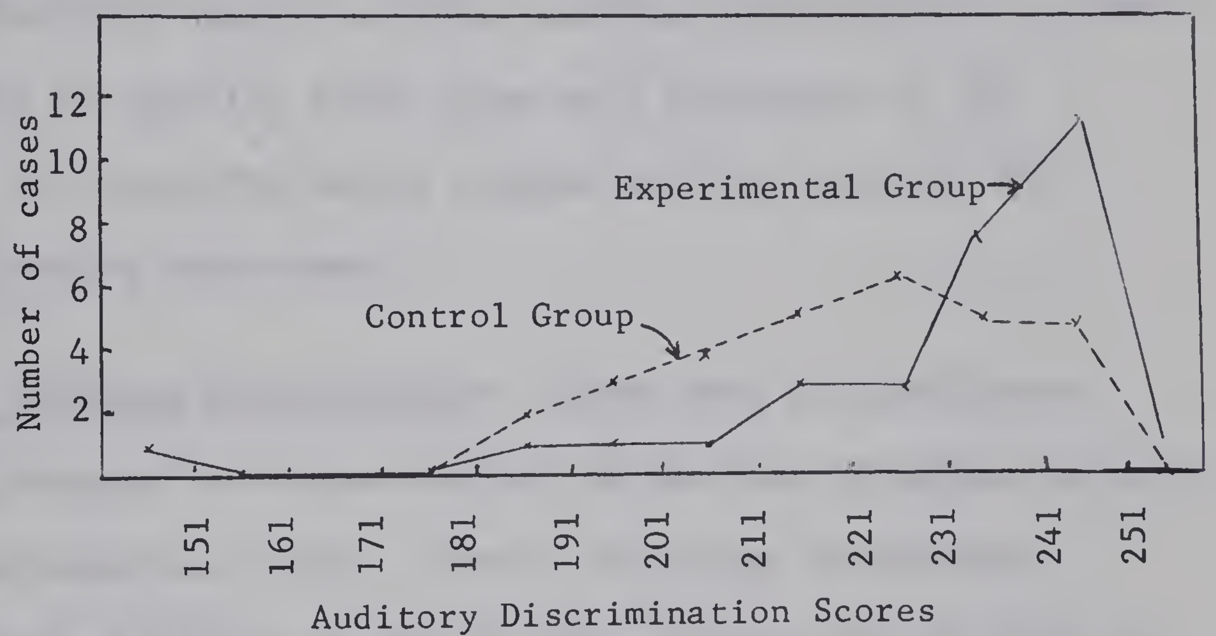

FIGURE 11

AUDITORY DISCRIMINATION POSTTEST SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS OF THE TEST SAMPLE

The mean posttest auditory discrimination score for the total sample was 225.43 and the standard deviation was 20.33. These scores indicate general improvement in ability to make auditory discriminations for both treatment groups between testing sessions. Practice effects and familiarity with the test from the May administration may have been partially responsible for the improvement in performance. It is likely, however, that there was some improvement in auditory discrimination.

The mean posttest auditory discrimination score for the experimental group was 230.0 and that for the control group was 220.9. These scores suggest that auditory training did result in improved ability to make auditory discriminations.

Effects of Treatments on Auditory Discrimination Scores

The interactions and effects of treatments and the bias variables--IQ, mental age, chronological age, sex, socio-economic status, and auditory acuity--on total auditory discrimination as well as performance on specific sound types were determined by the construction of regression models similar to those used for the analysis of reading achievement.

Total Auditory Discrimination. There were no significant interactions between treatments and any of the bias variables on total auditory discrimination scores. Hence, the change in auditory discrimination per unit of change in bias variables was the same for both treatments.

Tests to determine which treatment was more effective, however, found that the group which had received training in auditory discrimination was significantly superior to the control group at all levels of IQ, mental age, chronological age, socio-economic status, for both boys and girls, and for subjects with both borderline and adequate auditory acuity (Table XXX). Hence, Hypothesis One a) was rejected.

Training in auditory discrimination appeared to result in improved ability to make auditory discriminations for all types of subjects in the experimental group. Only a small number of children did not benefit from the word pair exercises.

TABLE XXX

F-RATIOS FOR THE INTERACTIONS AND EFFECTS OF TREATMENTS AND THE BIAS VARIABLES ON TOTAL AUDITORY DISCRIMINATION SCORES

Bias Variable	Interaction F-Ratios	Treatment Effects F-Ratios
IQ: Total	0.4827	11.5794**
IQ: Verbal (language)	0.1422	10.2893**
IQ: Non-Verbal (non-language)	0.5860	10.2963**
Mental Age: Total	0.4123	11.1134**
Mental Age: Verbal (language)	-0.0843	10.0671**
Mental Age: Non-Verbal (non-language)	0.4324	9.4252**
Chronological Age	1.5280	8.1283**
Sex	0.0504	7.9109**
Socio-Economic Status	0.9133	9.1915**
Auditory Acuity	0.2082	6.1971*

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

<u>Scores on Sound Contrasts</u>. None of the interactions between treatments and the bias variables on the performance of subjects on specific sound contrasts were significant except the interaction between treatments and mental age on the ability to discriminate affricate-fricative comparisons (Table XXXI). An estimate of the approximate level at which treatment effects were equal was made using the equation presented by Bottenberg and Ward (Appendix C). This estimate must be considered as an approximate rather than an exact point of equal treatment effects. Using this equation, the experimental group was found to perform better on affricate-fricative comparisons until the approximate mental age of 87.1 months. After this age the control group performed better. Hence, training in auditory discrimination appeared to benefit the younger but not older subjects in this sample on affricate-fricative comparisons.

F-ratios for the effects of treatments on ability to discriminate nasals, lateral-semivowel comparisons, affricate-fricative comparisons, and fricative-stop comparisons were not significant (Table XXXII). The experimental group was superior to the control group, however, on ability to discriminate stops at all levels of IQ, mental age, chronological age, socio-economic status, and for both sexes at the .01 level of confidence, and for subjects of both adequate and borderline acuity at the .05 level of confidence. The differences between treatment groups were also significant on fricatives at all levels of IQ and mental age at the .05 level of confidence. The benefit of training to performance on fricatives, however, appeared to diminish when the effects of sex, socio-economic status, chronological age, or acuity were held constant.

TABLE XXXI

F-RATIOS FOR THE INTERACTIONS OF TREATMENTS AND THE BIAS VARIABLES ON ABILITY TO DISCRIMINATE SPECIFIC SOUND CONTRASTS

Bias Variables	Stops	Nasals	Semivowel-lateral comparisons	Fricatives	Affricate-fricative comparisons	Fricative-stop comparisons
Total IQ	1.0018	0.0444	3.7189	0.3310	1.9701	0.8862
Total mental Age	0.3254	0.0065	3.0865	0.5712	4.3123*	1.0052
Chronological Age	1.7163	1.5986	0.2992	0.1500	0.0445	-0.0192
Sex	1.1676	0.6033	0.4244	0.0150	1.3541	1.3394
Socio-sconomic Status	0.4905	1.5293	0.0350	0.2265	0.2203	0.0972
Auditory Acuity	0.0214	0.1908	0.7018	0.3414	0.1584	0.8488

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

TABLE XXXII

F-RATIOS FOR THE EFFECTS OF TREATMENTS AND THE BIAS VARIABLES ON ABILITY TO DISCRIMINATE SPECIFIC SOUND CONTRASTS

Bias Variables	Stops	Nasals	Semivowel-lateral comparisons	Fricatives	Affricate-fricative comparisons	Fricative-stop comparisons
Total IQ	8.7937**	0.8487	0.8958	4.7135*	0.1997	1.4577
Total Mental Age	8.5854**	0.7547	0.9267	5.2359*		1.4577
Chronological Age	7.6065**	0.1847	0.3725	3.0228	1.0634	0.5606
Sex	7.9480**	0.3253	0.6509	3.5965	0.5217	0.6000
Socio-Economic Status	7.9772**	0.3548	0.6822	3.7051	0.5456	0.5864
Auditory Acuity	6.0282*	0.0708	0.6369	3.2725	0.3784	1.0735

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

The two sound types which yielded best to auditory training were the stops and fricatives. Stops were found in t-test comparisons to be the most difficult sound contrasts to discriminate. Evidently training in auditory discrimination reduced the difficulty of discriminating stops. The other sound contrasts which were found to be difficult, the nasals and fricative-stop comparisons, were not significantly improved by auditory training.

Voiced and Voiceless Sounds. The interactions of treatments and mental age, chronological age, sex, socio-economic status, and acuity on ability to discriminate voiced and voiceless sounds were not significant (Table XXXIII). The interaction of treatments and IQ on voiced sounds was significant, however, at the .05 level of confidence. The treatments were equally effective at an IQ of approximately 92.6. Auditory training appeared to benefit pupils with average to high IQ scores more than pupils with low IQ scores on discriminating voiced sounds.

F-ratios for treatment effects indicated that the experimental group performed slightly better than the control group on both voiced and voiceless sounds but that the differences were not significant when the effects of IQ, chronological age, sex, socio-economic status, or auditory acuity were taken into account. The experimenal group did, however, perform significantly better than the control group on voiceless sounds at the .05 level of confidence when the effects of mental age were held constant.

These results do not suggest any definite conclusions. However, auditory training appeared to improve the ability to discriminate voiceless sounds slightly more than voiced sounds.

TABLE XXXIII

F-RATIOS FOR THE INTERACTIONS AND EFFECTS OF TREATMENTS AND THE BIAS VARIABLES ON ABILITY TO DISCRIMINATE VOICED AND VOICELESS SOUNDS

	VOICED		VOICELESS	
Bias Variables	Interactions	Treatment Effects	Interactions	Treatment Effects
Total IQ	4.6097*		-0.0023	3.5822
Total Mental Age	3.0497	3.6356	0.2472	4.0939*
Chronological Age	1.4219	2.6716	0.0514	1.9304
Sex	0.1535	2.8198	1.0287	2.5077
Socio-economic Status	0.0496	2.8674	0.7205	2.5168
Auditory Acuity	0.5412	3.0217	0.1510	2.0748

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

Initial, Medial, and Final Sounds. None of the interactions of treatments and the bias variables on ability to discriminate sounds in the medial and final positions were significant. Interactions of treatments and both IQ and mental age on ability to discriminate sounds in the initial position were significant at the .05 level of confidence. The two treatments were equally effective at an IQ score of approximately 100. Auditory training appeared to benefit subjects of high average IQ more than subjects of low average IQ on sounds in the initial position (Table XXXIV).

The point of equal treatment effects for subjects on mental age was approximately forty-three months which was outside the range of observed scores. The experimental group was superior to the control group on discriminating sounds in the initial position throughout the range of observed mental age scores. The effectiveness of auditory training, however, diminished as mental age scores decreased.

The effects of treatments on ability to discriminate sounds in the initial, medial, and final positions were most evident for sounds in the final position. The experimental group was significantly better than the control group on sounds in the final position when the effects of IQ, mental age, sex, and socio-economic status were controlled. The differences between the treatment groups were not significant when auditory acuity or chronological age were taken into account. Apparently, chronological age and auditory acuity have more influence on the auditory discrimination of sounds than the position of the sounds in words. It has already been suggested that auditory discrimination is a developmental process and that some types of hearing disorders can have a profound influence on the discrimination of sounds in particular ranges

TABLE XXXIV

F-RATIOS FOR THE EFFECTS AND INTERACTIONS OF TREATMENTS AND THE BIAS VARIABLES ON ABILITY TO DISCRIMINATE SOUNDS IN THE INITIAL, MEDIAL AND FINAL POSITIONS

Bias Variables	INTERACTIONS			TREATMENT EFFECTS		
	Initial	Medial	Final	Initial	Medial	Final
Total IQ	5.6416*	0.1204	0.6532		1.348	6.2312*
Total Mental Age	5.2745*	0.2370	0.2370		1.3604	6.2106*
Chronological Age	0.5361	-0.0356	1.5296	1.3859	0.5881	3.6338
Sex	0.0327	2.3422	0.1785	1.4937	0.9934	4.0178*
Socio-Economic Status	1.2689	0.2500	0.7429	1.4939	0.9074	4.2058*
Auditory Acuity	2.4821	0.4715	0.0435	2.2392	0.8159	3.2229

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

of frequencies (Chapter III).

Auditory training did not result in significant improvement in the ability to discriminate sounds in the initial and medial positions (Table XXXIV).

It was indicated earlier that the final position was the most difficult position in which to discriminate sounds. It appears that the difficulty of discriminating sounds in the final position was decreased by training in auditory discrimination.

Like and Unlike Pairs. None of the interactions of treatments and the bias variables on ability to discriminate sounds in like and unlike pairs were significant (Table XXXV). Treatment effects, however, indicated that the experimental group was significantly better than the control group on like pairs when the effects of IQ, mental age, and socio-economic status were taken into account. When chronological age, sex, and acuity were held constant, however, the differences between the treatment groups on ability to discriminate sounds in like pairs were not significant.

None of the F-ratios for treatment effects on the ability to discriminate sounds in unlike pairs were significant although the performance of the experimental group was slightly better than that of the control group. It would appear that the auditory training in this study improved ability to hear similarities in speech sounds of words more than the ability to hear differences in speech sounds.

As suggested previously, the relative ease of hearing similarities as compared to differences in speech sounds is in accordance with the steps involved in perception. Since the perception of differentia is a

TABLE XXXV

F-RATIOS FOR THE INTERACTIONS AND EFFECTS OF TREATMENTS AND THE BIAS VARIABLES ON ABILITY TO DISCRIMINATE SOUNDS IN LIKE AND UNLIKE PAIRS

	INTERACTIONS		TREATMENT EFFECTS	
Bias Variables	Like Pairs	Unlike Pairs	Like Pairs	Unlike Pairs
Total IQ	-0.1648	0.6962	7,4801**	3.4317
Total Mental Age	0.0773	0.3089	6.1373*	3.7227
Chronological Age	-0.0503	2.1114	3.7806	2.2849
Sex	0.0434	0.7632	3.6411	2.5696
Socio-economic Status	0.3145	0.6473	4.2570*	2.7370
Auditory Acuity	2.7298	0.5313	2.1039	2.3401

*Significant at the .05 level of confidence = 4.01

**Significant at the .01 level of confidence = 7.12

more advanced process and is at least partially dependent on the perception of similarities, it is not surprising that a relatively short period of training would first bring about an improvement in ability to perceive similarities. Perhaps an extended program in auditory discrimination would result in improved ability to hear differences.

Summary and Final Comment

Taped training in auditory discrimination for four weeks resulted in improved performance in total auditory discrimination. Improvements were significant on stops and fricatives, on sounds in the final position, and on like word pairs. Hence, Hypotheses One a) and b) were rejected. A summary of the interactions and effects of treatments and the bias variables on reading achievement and auditory discrimination scores is presented in Table XXXVI.

The correlations between auditory discrimination and reading scores presented in Tables XXVIII and XXIX indicated that performance on some sound types, as measured by the Fast-Cosens Auditory Discrimination Test, was more highly related to reading achievement than performance on others. Auditory training improved performance on some of the sound types which were significantly related to reading achievement such as fricatives and final sounds. Improvement was also evident, however, on stops and like pairs but these were not related to reading achievement. Hence, some of the sound types which did improve as a result of the word pair exercises were slightly, but not significantly related to reading achievement. This could be another reason why the type of auditory discrimination training given in this study did not result

TABLE XXXVI

SUMMARY OF FINDINGS ON THE EFFECT OF TREATMENTS ON THE READING ACHIEVEMENT AND AUDITORY DISCRIMINATION OF PUPILS WHO WERE INITIALLY LOW IN AUDITORY DISCRIMINATION

	Scores on Reading and Auditory Discrimination Tests	Not Significant	Significant Interaction	Significant Effect	Interactions and Effects of Treatments and Bias Variables	Hypothesis Accepted	Hypothesis Rejected
READING	Oral Reading	*				1c	
	Silent Reading						
	Total	*				1d	
	Word Recognition		*		Girls benefited more than boys.		
	Comprehension	*					
AUDITORY DISCRIMINATION	Total Score			*	All subjects in the experimental group improved.		1a
	Sound Contrasts						
	Affricate-fricative comparisons		*		Younger subjects benefited more than older subjects.		
	Stops			*	All subjects in the experimental group improved.		1b
	Fricatives			*	Significant improvement when IQ and mental age held constant.		1b
	Nasals	*				1b	
	Semivowel-lateral comparisons	*				1b	
	Fricative-stop comparisons	*				1b	
	Voiced Sounds		*		Pupils with high average IQ benefited more than others.		
	Voiceless Sounds			*	Significant improvement when mental age was held constant.		1b
	Initial Sounds		*		Pupils with high IQ and mental age benefited more than than those with low scores.		
	Medial Sounds	*				1b	
	Final Sounds			*	Significant improvement when IQ, mental age, sex, and socio-economic status held constant.		1b
	Unlike Pairs	*				1b	
	Like Pairs			*	Significant improvement when IQ, mental age, and socio-economic status held constant.		1b

in a significant improvement of reading scores.

III. SUMMARY OF FINDINGS

The performance of the total test population on the Fast-Cosens Auditory Discrimination Test was analysed in several ways. A consideration of their performance on specific types of sounds led to the following summary:

1. The total test population scored significantly lower on items testing discrimination of stops and nasals than on lateral-semivowel comparisons, fricatives, or stop-fricative comparisons. Stops were the most difficult sounds to discriminate and nasals were the second most difficult.

2. The total test population scored significantly lower on stop-fricative comparisons than on lateral-semivowel comparisons or affricate-fricative comparisons. Stop-fricative comparisons were the third most difficult sound contrast.

3. There were no significant differences between mean test scores on affricate-fricative comparisons, fricatives, and lateral-semivowel comparisons. These were relatively easy sound contrasts to discriminate.

4. The total test population scored significantly better on all voiceless than all voiced sounds.

5. A consideration of voicing within sound contrasts indicated that mean test scores were significantly higher on voiceless than on voiced stops, and on voiceless than on voiced fricatives. There was no significant difference, however, between mean test scores on voiceless and voiced affricate-fricative comparisons or on voiced and voiceless

stop-fricative comparisons.

6. There was a significant difference between mean test scores on sounds in the initial, medial, and final positions. Discriminating sounds in the final position was most difficult, in the initial position was second in difficulty, and in the medial position was the easiest of the three.

7. There was a significant difference between mean test scores on like and unlike pairs. Hearing similarities between speech sounds was easier than hearing differences between speech sounds.

A consideration of the effect of bias variables on ability to make auditory discriminations revealed the following results:

1. The boys were slightly superior to the girls on total auditory discrimination score and on all sound types. The difference was significant, however, only on like pairs.

2. Older subjects were slightly superior to younger subjects on total auditory discrimination score and on all sound types except like pairs. The only differences that were significant were on lateral-semivowel comparisons and sounds in the initial position.

3. There was no significant differences between mean test scores on total auditory discrimination and all sound types for subjects of high and low socio-economic status. Test scores of subjects from high socio-economic status, however, were slightly higher than those of subjects from low socio-economic status.

The use of multiple linear regression models to determine the effects and interactions of treatments and the bias variables--IQ, mental age, chronological age, sex, socio-economic status, and auditory acuity--on reading achievement and auditory discrimination, produced

these findings:

1. The interactions and effects of treatments and the bias variables on oral reading achievement were not significant. Auditory training did not improve oral reading performance.

2. There were no significant interactions or effects of treatments and the bias variables on total silent reading achievement. Hence, auditory training did not improve total silent reading performance.

3. There were no significant interactions of treatments and IQ, mental age, chronological age, socio-economic status, or auditory acuity on word recognition scores. The interaction between treatments and sex on word recognition, however, was significant. Auditory training appeared to benefit girls more than boys on word recognition scores.

4. The effects or interactions of treatments and the bias variables on comprehension test scores were not significant. Hence, auditory training did not improve comprehension.

5. The interactions of treatments and the bias variables on total auditory discrimination scores were not significant. There was a significant difference, however, between the control and experimental groups when all bias variables were held constant. Auditory training resulted in improved ability to make auditory discriminations as measured by the Fast-Cosens Auditory Discrimination Test.

6. There were no significant interactions between treatments and bias variables on ability to discriminate specific sound contrasts except the interaction between treatments and mental age on affricate-fricative comparisons. Auditory training appeared to benefit subjects of lower mental age more than subjects of higher mental age on

affricate-fricative comparisons. The effects of treatments on nasals, lateral-semivowel comparisons, fricative-stop comparisons, and affricate-fricative comparisons were not significant. The experimental group scored significantly higher than the control group on stops, however, when all bias variables were held constant. Differences were also significant on fricatives for all levels of IQ and mental age.

7. The interactions of treatments and mental age, chronological age, sex, socio-economic status, and auditory acuity on ability to discriminate voiced and voiceless sounds were not significant. The interaction between treatments and IQ on voiced sounds was significant. Auditory training was of more benefit to subjects with average to high IQ scores than subjects with low IQ scores. There were no significant differences between the experimental and control groups on either voiced or voiceless sounds when the effects of IQ, chronological age, sex, socio-economic status, or auditory acuity were held constant. The experimental group did perform significantly better than the control group on voiceless sounds, however, for all levels of mental age.

8. There were no significant interactions of treatments and bias variables on ability to discriminate sounds in the medial and final positions. The interaction of treatments and both IQ and mental age on ability to make auditory discriminations in the initial position were significant. There were no significant treatment effects for sounds in the initial and medial positions, but the experimental group scored significantly higher than the control group on sounds in the final position when all bias variables except auditory acuity and chronological age were controlled.

9. There were no significant interactions of treatments and

bias variables on ability to make auditory discriminations in like or unlike pairs. The effects of treatments on unlike pairs were also not significant. The experimental group, however, performed significantly better than the control group on like pairs for all levels of IQ, mental age, and socio-economic status.

CHAPTER VII

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

This chapter will present a brief summary of the study and outline the main findings. Conclusions will then be drawn from findings which appear definitive enough for generalization to other similar populations. Implications of these conclusions for instruction will be discussed and recommendations for further study will be made.

I. SUMMARY OF THE STUDY

The purpose of this study was to determine the effect of training in auditory discrimination on both the reading achievement and the auditory discrimination of grade one subjects who scored low on an auditory discrimination test. It also investigated the relative difficulty of discriminating sound types and specific sounds for children in the total test population. An attempt was made to determine the relationship between selected bias variables and the ability to make auditory discriminations.

The test sample consisted of sixty subjects from four classrooms in two Edmonton Public Schools. Subjects were selected on the basis of scores obtained on auditory discrimination and auditory acuity tests. The experimental study involved a pretest-treatment-posttest comparison of subjects given training in auditory discrimination with subjects not given training. The treatment consisted of a four week training period from the middle of May to the middle of June. Pretest and posttest scores were obtained for oral reading, silent reading, and auditory discrimination. Intelligence tests were also administered. All tests

were marked and their results analysed by the investigator.

II. MAIN FINDINGS AND CONCLUSIONS OF THE STUDY

Conclusions will be drawn in relation to the testing of hypotheses outlined in Chapter I.

Hypothesis One

There will be no significant effects or interactions of treatments and:
(1) intelligence
(2) mental age
(3) sex
(4) chronological age
(5) socio-economic status
(6) auditory acuity

on the following criteria scores:
a. total auditory discrimination of speech sounds
b. auditory discrimination of specific sound types
c. oral reading
d. silent reading
i. word recognition
ii. comprehension

a. Total Auditory Discrimination of Speech Sounds. There were no significant interactions of treatments and bias variables on total auditory discrimination test scores. The differences between the experimental and control groups on total auditory discrimination scores, however, were highly significant. Therefore Hypothesis One a) was rejected.

Taped training in auditory discrimination near the close of the grade one school year each school day for four weeks resulted in increased scores on total auditory discrimination as measured by the Fast-Cosens Auditory Discrimination Test. Improvement was made by subjects at all levels of IQ, mental age, chronological age, socio-economic status, for

both sexes, and for subjects with both adequate and borderline auditory acuity. On the basis of this finding, it was concluded that word pair exercises presented at listening centers near the close of the grade one year would benefit pupils from large urban centers who are low in auditory discrimination by increasing their ability to discriminate sounds.

b. Auditory Discrimination of Specific Sound Types. The following types of sounds were considered: sound contrasts, voiced and voiceless sounds, sounds in the initial, medial and final positions, and like and unlike word pairs. For each of these types of sounds, some of the effects or interactions of treatments and the bias variables were significant. Therefore Hypothesis One b) was rejected. The main findings and conclusions related to this hypothesis are presented below.

1. Taped training in auditory discrimination resulted in an improved ability of pupils in the test sample to discriminate stops and fricatives. Improvement on stops was evident for subjects at all levels of IQ, mental age, chronological age, socio-economic status, for both sexes, and for subjects with both adequate and borderline auditory acuity. The effect of treatments on fricative scores was not significant when chronological age, socio-economic status, sex, and auditory acuity were held constant. A similar training program in auditory discrimination would probably result in more improvement in the discrimination of stops than other sound contrasts.

2. Training in auditory discrimination improved performance on voiceless sounds more than voiced sounds for all levels of mental age. However, when the effects of IQ, chronological age, sex, socio-economic

status, and auditory acuity were held constant, the difference between the experimental and control groups lost significance. Hence, no overall conclusions concerning the effect of auditory training on voiced as compared to voiceless sounds can be made.

3. Training in auditory discrimination improved the ability to discriminate sounds in the final position more than sounds in either the initial or medial positions. Since the experimental group scored significantly higher than the control group on sounds in the final position for all levels of IQ, mental age, chronological age, socio-economic status, and both sexes, this conclusion is probably generalizable to a similar population.

4. Auditory discrimination training improved the ability of subjects to make auditory discriminations in like pairs more than unlike pairs for all levels of IQ, mental age, and socio-economic status. Hence, this type of training could be expected to increase the ability of pupils from similar populations to hear similarities of speech sounds in words more than differences.

c. Oral Reading Achievement. There were no significant effects or interactions of treatments and IQ, mental age, chronological age, sex, socio-economic status, or auditory acuity on oral reading achievement. Therefore Hypothesis One c) was accepted. Training similar groups of children low in auditory discrimination near the close of the grade one year is not likely to bring significant improvements in oral reading achievement.

d. Silent Reading Achievement. Silent reading was considered both as a total score and as two separate scores, word recognition and

comprehension. None of the effects of treatments on total silent reading achievement scores, word recognition, or comprehension scores were significant when IQ, mental age, chronological age, socio-economic status, sex, or auditory acuity were held constant. Only one of the interactions of treatments and a bias variable was significant and this was on word recognition. Hence, Hypothesis One d) was accepted and it was concluded that training in auditory discrimination would not result in improved silent reading achievement for similar groups of pupils.

Hypothesis Two

> There will be no significant difference in ability to make auditory discriminations among the following types of sounds:
>
> a. sound contrasts
>   i. stops
>   ii. nasals
>   iii. semivowel-lateral comparisons
>   iv. fricatives
>   v. affricate-fricative comparisons
>   vi. fricative-stop comparisons
>
> b. voiced and voiceless sounds
>
> c. sounds in initial, medial and final position
>
> d. like and unlike pairs

a. Sound Contrasts. There were significant differences between mean scores of the total test population on stops and nasals as compared to lateral-semivowel comparisons, fricatives, affricate-fricative comparisons, or fricative-stop comparisons. Scores on stop-fricative comparisons were also significantly different than scores on lateral-semivowel comparisons and affricate-fricative comparisons. On the basis of this evidence Hypothesis Two a) was rejected. The findings and conclusions reached concerning this hypothesis follow.

1. Stops and nasals were the two most difficult sound contrasts. Mean test scores on both stops and nasals were significantly lower than

test scores on all other sound contrasts.

2. Fricative-stop comparisons were the third most difficult sound contrast to discriminate. Mean test scores on fricative-stop comparisons were significantly lower than test scores on affricate-fricative comparisons or lateral-semivowel comparisons.

3. Fricatives, affricate-fricative comparisons, and semivowel-lateral comparisons were the easiest sounds to discriminate. There were no significant differences between the mean test scores on these three sound contrasts.

The order of difficulty of sound contrasts for pupils in similar populations may not be exactly the same as outlined above. It is likely, however, that stops and nasals would be more difficult than the other sound contrasts if the Fast-Cosens Auditory Discrimination Test was used as the measuring instrument.

b. Voiced and Voiceless Sounds. There was a significant difference between subjects on ability to discriminate all voiced as compared to all voiceless sounds. There were also some significant differences in mean test scores on voiced and voiceless sounds within specific sound contrasts. On the basis of this evidence Hypothesis Two b) was rejected.

The total test population performed significantly better on all voiceless than on all voiced sounds. Mean test scores on voiceless stops as compared to voiced stops and voiceless as compared to voiced fricatives also revealed significant differences in favor of voiceless sounds. Although there were no significant differences between voiced and voiceless affricate-fricative comparisons or between voiced and voiceless

stop-fricative comparisons, the conclusion was drawn that voiceless sounds tend to be easier than voiced sounds for grade one pupils low in auditory discrimination.

c. Sounds in Initial, Medial and Final Positions. There were significant differences between mean test scores on sounds in the initial, medial, and final positions. Hence, Hypothesis Two c) was rejected.

Final sounds were significantly more difficult to discriminate than initial or medial sounds, and sounds in the initial position were significantly more difficult to discriminate than sounds in the medial position. This order of difficulty is probably generalizable to similar populations.

d. Like and Unlike Pairs. There was a significant difference between mean test scores on like and unlike pairs. On the basis of this evidence Hypothesis Two d) was rejected and it was concluded that hearing similarities of speech sounds in words was an easier discriminatory task for grade one children low in auditory discrimination than hearing differences of speech sounds in words.

Hypothesis Three

There will be no significant relationship between ability to make auditory discriminations and

a. sex
b. chronological age
c. socio-economic status

a. Sex. There were no significant differences between mean test scores of boys and girls on any auditory discrimination score except like pairs. Therefore Hypothesis Three a) was accepted. It appears, however,

that boys tend to hear similarities of speech sounds in words better than girls.

b. Chronological Age. There were no significant differences between mean test scores of older and younger subjects except on lateral-semivowel comparisons and sounds in the initial position. Therefore Hypothesis Three b) was accepted although it appeared that older subjects tended to discriminate lateral-semivowel comparisons and sounds in the initial position better than younger subjects.

c. Socio-economic Status. There were no significant differences between mean test scores of subjects from high socio-economic and subjects from low socio-economic status on any auditory discrimination score. On the basis of these results Hypothesis Three c) was accepted. The relationship between socio-economic status and ability to make auditory discriminations was not significant. The limited range of socio-economic groups involved in this study, however, may have prevented the results from reaching significance.

Summary

Taped training for pupils low in auditory discrimination near the close of the grade one school year brought improvements in total auditory discrimination as measured by the Fast-Cosens Auditory Discrimination Test. Improvements were significant on stops and fricatives, on sounds in the final position, and on like pairs. There was no significant improvement in oral or silent reading achievement as a result of the auditory training.

It was discovered that stops and nasals were the most difficult

sounds for grade one subjects to discriminate. Fricative-stop comparisons were third in difficulty and fricatives, affricate-fricative comparisons, and semivowel-lateral comparisons were the easiest sound contrasts to discriminate. Voiceless sounds tended to be easier to discriminate than voiced sounds. It was most difficult to make auditory discriminations when sounds were in the final position. The initial position was second in difficulty and the medial position was the easiest in which to discriminate sounds. Finally, hearing similarities of speech sounds in words was easier than hearing differences.

Although test scores suggested a relationship of sex, socio-economic status, and chronological age with ability to make auditory discriminations, significance was not reached.

III. LIMITATIONS OF THE FINDINGS

The findings of this study were subject to the following limitations:

1. The conclusions reached in this study concerning the effectiveness of training in auditory discrimination must be limited to training programs instituted near the end of the grade one year for children low in auditory discrimination. It is possible that a training period near the beginning of the grade one year would produce a different effect on reading achievement. Perhaps the ability to discriminate speech sounds in words is more important to reading achievement when word attack skills are first being developed and when word meanings are first being extended than after the basis for these skills has been established.

2. The conclusions of this study are also limited to a relatively short training program of four weeks. More impact on reading achievement

may have resulted if a longer period of auditory training had been given.

3. This study was limited to grade one subjects in two schools from middle socio-economic areas. A stronger relationship between auditory discrimination and both chronological age and socio-economic status may have been apparent if there had been more variation among subjects on these variables.

4. Added administration time from individual and small group testing necessitated testing children at times when peak performance was not possible. The auditory discrimination test was also somewhat long for pupils with relatively short attention spans. One other limitation on test results was the time of year when posttesting was conducted. Many children were tired and anxious for the onset of holidays during the final weeks of June.

IV. IMPLICATIONS OF THIS STUDY

This study clearly demonstrated that the ability to hear similarities and differences of speech sounds in words can be improved through instruction. Although maturation is probably an important factor, auditory training need not be delayed beyond the end of the grade one school year.

All students in the test sample benefited from auditory discrimination training by obtaining increased test scores in auditory discrimination. However, since training was limited to subjects below the 60th percentile on the Fast-Cosens Auditory Discrimination Test, this did not include all subjects in a normal classroom. Hence, provision should be made for continuous training in auditory discrimination for all pupils low in auditory discrimination throughout the grade

one year.

Discrimination of certain sound types appeared to yield to training more than discrimination of others. Teachers should, therefore, realize that auditory discrimination training may not increase the discriminability of all types of sounds. The type of auditory discrimination training in the present study resulted in improved ability to discriminate stops and fricatives, sounds in the final position and similarities of speech sounds in words. Perhaps other types of programs could be developed to improve auditory discrimination of other types of sounds.

Taped training via listening centers appeared to be an effective means of teaching auditory discrimination. The word pair exercises developed for the study also appeared to be effective in improving ability to discriminate sounds. The auditory discrimination test developed for this study is a fairly comprehensive instrument which may aid clinicians and teachers in the testing of students suspected of being low in auditory discrimination at the primary level.

Special training in auditory discrimination near the close of the grade one year did not result in improved reading achievement. Hence, it is probably not advisable to undertake a training program of four weeks duration in auditory discrimination to improve overall reading achievement near the end of the grade one year. Since correlations between auditory discrimination and silent reading achievement were significant, however, it is probable that improvement in the ability to make auditory discriminations would result in increased silent reading scores at some point in a child's school career. Perhaps auditory discrimination training near the beginning of the grade one

year when considerable attention is being given to the formation of word attack skills and word meanings, would have a significant impact on reading achievement.

One final implication for classroom instruction can be drawn from the finding that thirty-six per cent of the subjects in the test population who scored below the 60th percentile on the Fast-Cosens Auditory Discrimination Test had inadequate auditory acuity. Many children are attempting to function in normal classroom situations with a hearing loss. There is a definite need for the provision of routine hearing assessments at the beginning of the grade one year.

V. RECOMMENDATIONS FOR FURTHER RESEARCH

1. A similar study with a much longer training program should be conducted near the beginning of the grade one year when the foundations for the development of word analysis skills and word meanings are being established.

2. A further study might examine the relationship between the ability to make auditory discriminations and bias variables other than those considered in the present study. It would be interesting to investigate the nature and extent of the relationship between preferred sensory mode and auditory discrimination. Bilingualism might also be considered.

3. Testing at regular intervals would indicate the maturational sequence in the development of ability to make auditory discriminations. Perhaps studies such as those undertaken in the area of articulation would indicate the sequence and rate of development in discrimination of specific sounds and types of sounds. Knowledge of the maturational

sequence could be used to plan a training program. The sequential development of auditory discrimination in the presence and absence of auditory discrimination training could then be compared.

4. It would be interesting to investigate the relationship of auditory discrimination to other aspects of the school curriculum such as spelling or phonics.

VI. CLOSING STATEMENT

This study investigated the effect of taped training in auditory discrimination on the reading achievement and the auditory discrimination of grade one pupils low in auditory discrimination.

The four week auditory discrimination training program resulted in improved scores on total auditory discrimination and on the discrimination of several sound types. Improvements in auditory discrimination did not transfer to oral and silent reading. Auditory discrimination training presented near the beginning of the grade one year for an extended period of time would probably improve reading performance.

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A P P E N D I C E S

APPENDIX A:

THE FAST-COSENS AUDITORY DISCRIMINATION TEST

I. Directions for the Fast-Cosens Auditory Discrimination Test

The child is seated facing the examiner. If more than one child is being tested, dividers are placed to prevent observation of responses made by other children.

Say: "I would like to find out how well you can listen. To do this, I would like to have you listen to words on this tape recorder. A voice will say two words. Sometimes the two words will be exactly the same two words such as my, my. Others will be just a little bit different such as my, by. I would like to have you listen to these two words and tell me if they are the same two words or if they are a little bit different: wide, ride. Are they the same or different?" Give each examinee an opportunity to respond. Say: "So each of you won't hear what the others say, I want you to show me whether the words are the same or different. If the words are the same, keep your hands on your lap. If the words are different, put your hand up. Listen to these two words: thimble, thimble. Are they the same or are they different? Show me." If any of the examinees do not make the correct response, repeat the directions. Give the following practice pairs orally correcting errors as they occur.

zip gyp
fell fell
nice knife
paint faint

Say: "Now I would like to have you listen to words on the tape recorder and show me whether they are the same or different. Remember, put your hand up if the words are different and keep your hands on your lap if they are the same." Start the tape recorder but do not record responses until the recorded practice items have been given. The recorded practice items are:

rack rat
bag bag
cup cut
wide wide
slimmer slinger
lung rung

II. Fast-Cosens Auditory Discrimination Test

Part One

witch wish
cap cap
bug bug
pleasure pledger
chin chin
seed seed
ring wing
first thirst
volt bolt
harsh harsh
shake shake
sheep cheap
reshine reshine
sink sink
lease leash
gaze gaze
red red
hash hatch
wed wed
dare dare
sheet sheet
pie thigh
raging raging
peeve peeve
slim sling
brimming brimming
nice nice
leap weep
breed breathe
wife wife
bad bag
thatch thatch
shape shape
had has
region reason
mess mess
cherry sherry
lath lash
by by
thine vine
tenth tenth
switches swishes
wishing wishing
chains change
swimming swinging
swim swim
elect erect
led led
boat boat

robe rode
clove clove
rocking rotting
van van
rash wrath
lap lap
muscle muffle
shack sack
range range
card card
lathe laid
shin shin
bathe bathe
then then
lath lass
day they
lit lit
way lay
legion legion
lash latch
by thy
cup cup
teething teething
bid bid
lesion legion
laid laid
simmer simmer
fought thought
ban van
wrath wrath
lass lash
sack sack
fearing feeling
roughing roughing
thought thought
thin thin
mesh mess
lap rap
rub rub
rap wrath
day day
popping potting
sherry sherry
thatch patch
ring ring
reason reason
has has
pick thick
grease grease

muff muff
ran rang
pie pie
peep peep
raising raging
push push
cheat sheet
bat bat
lit lick
leap leap
thy vie
cashing cashing
rains range
brimming bringing
slim slim
cad cad
clove clothe
waking waiting

vow vow
hearth harsh
rate rate
shake sake
page page
had had
bathe bade
thy thy
tenth tense
sing sing
dare there
lot lot
wait late
elect elect
pleasure pleasure
sinner sinner
mush muff

Part Two

bath bath
shief thief
muss muff
cad cab
pushy pushy
cashing catching
reep reep
feeling feeling
grief grease
thorn thorn
waking waking
winning winging
popping popping
roughing rushing
clang clang
page pays
rate late
sun sung
thy thy
bail vale
rub rug
half hash
raft raft
fence thence
rung rum
cuffing cuffing
beater beaker
lot lock
peak peep
wing wing

naval naval
arriving arising
thy die
has have
lasses lashes
thigh thigh
fought fought
cog cob
hopper hotter
crutches crutches
bat that
pass pass
big bid
singer simmer
chat chap
lathe lave
dish dish
after aster
vow thou
sought thought
buzz buzz
wag rag
lashing laughing
closing clothing
late late
lens lend
lash lash
rising rising
wins wins
thank shank

rig rig
sheep sheath
latch latch
pup puff
winging winging
aster aster
witches wishes
web wed
lease lease
coke cope
puff puff
shoot shoot
laugh lash
sheep sheep
closing closing
leaf lease
thief thief
hash hash
beaker beaker
sinner singer
upper upper
refine reshine
swinging swinging
thin thin
gaze gaze
lashing lashing
red led
win wing
tug tub
lasses lasses
clam clang
muffle muffle
lake late
shape shake
rack rack
thimble symbol
sung sung

arising arising
naval nasal
shot shop
peeve pease
hotter hotter
pussy pushy
first first
thence thence
bolt bolt
slitting slipping
switches switches
chat chat
thee be
mouse mouse
led leg
laugh laugh
rotting rotting
vale vale
sift shift
cap cat
lathe lathe
cuffing cussing
there there
sink think
raft waft
rising writhing
wind wins
wag wag
teething teasing
shin thin
cog cog
wreath reap
soak soak
wish wish
leap leaf
pass path

APPENDIX B:

AUDITORY DISCRIMINATION LESSONS

I. Introduction

Say: "Each one of you has a new book in front of you. This book has some interesting pages which will help you learn to listen carefully. I will tell you how to do each page through the ear phones you have on. Your job is to see how well you can use your ears. Pick up your pencil and put your name on the cover of your book as neatly as you can."

II. Instructions for Word Pair Exercises

A. Use Your Ears!

Say: "Turn your book to page ____. Bend the cover back and fold it under your book so you can only see page ____.

Look at box A. There are two pictures in box A. I want you to take your pencil and put an X on ____. Look at box B. Put an X on ____. Now move to box C. Put an X on ____."

Repeat for each box.

Say: "Now we are going to check the work you just finished together. Look back at box A. Your X should be on the picture of the ____ which ____. If you put an X on the picture of the ____ put a small check mark in the corner of box A. If you were not right, erase your answer and put an X on the picture of the ____. Listen to the difference between ____ and ____." Repeat the word pair. "Move to box B. You were right if you put an X on the picture of the ____ which ____. If you had an X on the ____, put a check mark in the corner. If your check mark is not on the right picture, erase your answer and put an X on the ____. Listen to the difference between ____ and ____." Repeat the word pair.

Repeat instructions for each box.

When all corrections have been made say: "Count the number of check marks on your page and put that number at the top of the page. If you had the number ____ you were a good listener."

B. Who Will Win!

Say: "Open your book to page ____. Turn your pages right back so all you can see is page ____.

Today you are going to play a game to see who will win a race. The characters racing are ____. If you listen very carefully, you will find out who will win this race.

Look at the first row or track on which the ____ are running. Put your finger on the first ____. I am going to say two words. If the two words are different, put an X on the first ____. If the two words are not different, if they are the same, don't move your finger. Listen to these two words: ____, ____. Remember, if the words are different put an X on the first ____. If they're the same two words, don't move your finger. If you listened very carefully, you should have an X (or your finger should still be) on the first ____, because ____, ____ are different (the same). Your finger should now be on the ____. Listen to these two words: ____, ____. ____, ____ were different (the same) so you should have put an X (or your finger should still be) on the ____."

Repeat for each pair.

At the end of each track say: "Count the number of ____ which have an X on them and put that number on the line at the end of the row. The ____ won today because all the ____ are marked."

C. Can You Find Them All!

Say: "Open your book to page ____. Turn your pages right back so you can only see page ____.

This page is different than the pages you have already done. In each box there are four pictures. Sometimes the word I give will name two of the pictures in the box. When it names two of the pictures, you will put a mark on each of the two pictures. Sometimes the word I say will name only one of the four pictures. Then you are to put a mark on only one picture. Remember, the word I say may name one OR two pictures in a box.

Look at box A. I want you to put an X on ____. Look carefully and make sure you have an X on all the pictures that can be named ____. Let's see how well you listened. You should have an X on one (two) picture(s). One X should be on the ____ which ____ (and the other X should be on the ____ which ____). Now put an O on ____. You should have an O on one (two) picture(s). There should be an O on the ____

which ____ (and the ____ which ____). If you had an X on the picture of the ____ which ____ (and the ____ which ____) and an O on ____ which ____ (and the ____ which ____) put a check mark in the corner."

Repeat for each box.

Say: "Count the number of check marks on your page and put that number at the top of the page. If you had ____ right, you were a good listener."

D. Play Bingo!

Say: "Open your book to page ____. Turn the pages right back so you can only see page ____.

Today you are going to play bingo. Some of you probably know how to play bingo already but you'll have to listen carefully because this game is a little different than the bingo you usually play.

Look down and find the B. But your finger in the first box under the B. There is a star in this box.* I am going to say two words. If they are different, put an X in the box with the star in it. If they are the same, leave the box empty and move your finger down to the next box. Listen to these two words: ____, ____. ____, ____ were different (the same) so you should have an X in that box (or leave that box empty) and move down to the next box. Your finger should now be in the box with the jack in it."

Repeat instructions for each box.

When all boxes have been completed, say: "Now let's see how many bingos you have. The pictures at the bottom of the page show you what a bingo looks like.* Put a line through all your bingos. Count the number of bingos on your page and put that number at the top of the page. If you had ____ bingos, you were listening very carefully."

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*Pictures were included only in the first bingo lesson.

III. Key for Word Pair Exercises

Page One

A. pup the pup that is a baby dog
B. lake the lake you can swim in
C. car the car you can ride in
D. sleep the girl sleeping in bed
E. swim the boy swimming in the water
F. boat the boat floating on the water

Page Two

Track One	Track Two	Track Three
shaping shaking	leap leap	then den
tub tug	vow thou	budge buzz
lake lake	thine thine	bath bash
bug bud	grave grave	sift sift
hatch hatch	thin pin	rod rob

Page Three

A. wash the girl who is washing
B. pail the pail that is used to carry water
C. wedding the wedding where people are being married
D. sling the man's arm in a sling
E. cap the cap for a boy to wear on his head
F. ring the ring ladies wear on their finger
G. ten the number ten
H. write the girl who can write a letter

Page Four

A. fly the bird that can fly
the house fly
fry the eggs that fry
B. bat the bat you hit a ball with
the bat that can fly
back the girl's back
C. pen the pen you write with
the pen babies play in
pan the pan mother fries food in
D. rack the rack towels hang on
rock the rock laying in the grass

Page Five

Under the B	Under the IN	Under the GO
slimmer slinger	there bear	coke coke
wife life	shorn thorn	butler butler
breathe breathe	zoo zoo	nice knife

Page Six

A. cut the scissors that can cut
B. neck the girl's neck
C. ball the ball that can bounce
D. fry the eggs that fry in the pan
E. leash the leash you use to walk your dog
F. cherry the cherry that is good to eat
G. sheet the sheet that is hanging on the line
H. licks the child who licks the lollipop
I. potting the man who is potting plants
J. file the file you use to clean your nails

Page Seven

Track One	Track Two	Track Three
lisp list	mail mail	insect infect
wing wing	one one	thimble thimble
lap lap	push puss	voat boat
bidder bigger	nabbing nagging	grave graze
gay day	fought fought	offer awful

Track Four	Track Five
sleep sleep	jest zest
lathe laid	thee thee
zone zone	boat boat
fond fond	pull full
wreath reap	leisure ledger

Page Eight

A. run the girl that can run
B. suit the suit father can wear
C. mouth the mouth with lips and teeth
D. crown the crown for a king
E. tie the tie father can wear
F. stool the stool you can sit on
G. beater the beater to beat eggs
H. fort the fort to protect settlers from Indians
I. bell the bell that can ring
J. fat the man that is fat

Page Nine

Under the B

reap reap
mating making
first thirst
gay gay
zeal deal

Under the I

shake fake
shine shine
fin thin
upper utter
swing swing

Under the N

making making
fail sail
sought thought
cow cow
file file

Under the G

huffing hushing
witches wishes
bass bath
loaf loaf
neck neck

Under the O

half hath
hook hook
shread thread
three free
scream stream

Page Ten

A. led the boy who led his dog
B. grass the grass around the tree trunk
C. tea the tea in the cup
D. bun the bun on the plate
E. sung the girl who sung a song
F. closing the girl closing the door
G. rack the rack to hang towels on
H. sack the sack with flour or oats in it
I. shack the shack that's an old house
J. spring the spring that can stretch

Page Eleven

Track One

thumb some
rage rage
Joan zone
pat pet
vest vest

Track Two

fake fake
gaming gaining
oaken open
nab nag
rage raise

Track Three

grass graph
gaming gaming
open open
elect erect
bass bath

Track Four

hath hath
bell bell
them then
harp heart
bigger bigger

Track Five

bid bid
thrill frill
streak streak
zeal veal
some sun

Page Twelve

A. mail the letters which come in the mail
B. talk the boy who can talk on the telephone
C. smile the girl with the happy smile
D. rung the rung on the ladder
E. hook the hook you catch a fish with
F. chip the chip from the broken pitcher
G. pan the pan you cook food in
H. map the map to show you where you are travelling
I. card the card you play a game with
J. wag the dog that can wag its tail

Page Thirteen

A. pin the straight pin
the safety pin
pen the pen you write with
B. chips the chips you can eat
the chips from the broken pitcher
pick the pick you dig a hole with
C. cat the cat that can catch mice
cap the cap you can wear on your head
the cap for a bottle of pop
D. red the color red
the girl who read a book
rode the boy who rode a horse
E. swing the swing you can ride on
ring the ring you can wear on your finger
F. cut the scissors that can cut
cot the cot you can sleep on

Page Fourteen

Under the B	Under the I	Under the N
squeak streak	heart heart	huffing huffing
grass graph	shock chalk	key key
zest vest	slimmer slimmer	bash batch
some sung	spool spool	leisure leisure
breathe breeze	shread thread	hid had

Under the G	Under the O
cap calf	zest zest
three three	noon none
wreathe wreathe	smile smile
clove clothe	fly fly
scream stream	lathe lave

Page Fifteen

A. win the boy who wins the race
B. rub the dog that rubs on the man's leg
C. rip the piece of cloth with the rip in it
D. singer the lady who is a singer
E. parrot the parrot that is a bird
F. clam the clam with two shells
G. kill the girl who is going to kill a fly
H. crab the crab that lives in the ocean

Page Sixteen

Track One

bag bag
oaf oath
first first
bedding begging
closing closing

Track Two

writhing rising
net net
beige bathe
bun bun
lathe laze

Track Three

risk wrist
thin thin
pill pill
leisure leather
paint faint

Track Four

they bay
shrunk slunk
crab crab
grew drew
risk risk

Track Five

glass glass
shrine swine
zeal zeal
wag wag
them gem

Page Seventeen

A. cub the cub that's a baby bear
B. hips the boy with his hands on his hips
C. tug the dog that tugs at the boy's trousers
D. met the men who met
E. sharing the girls who are sharing candy
F. sand the sand in the toy bucket
G. lap the dog on the girl's lap
H. dip the boy who dips his foot into the water

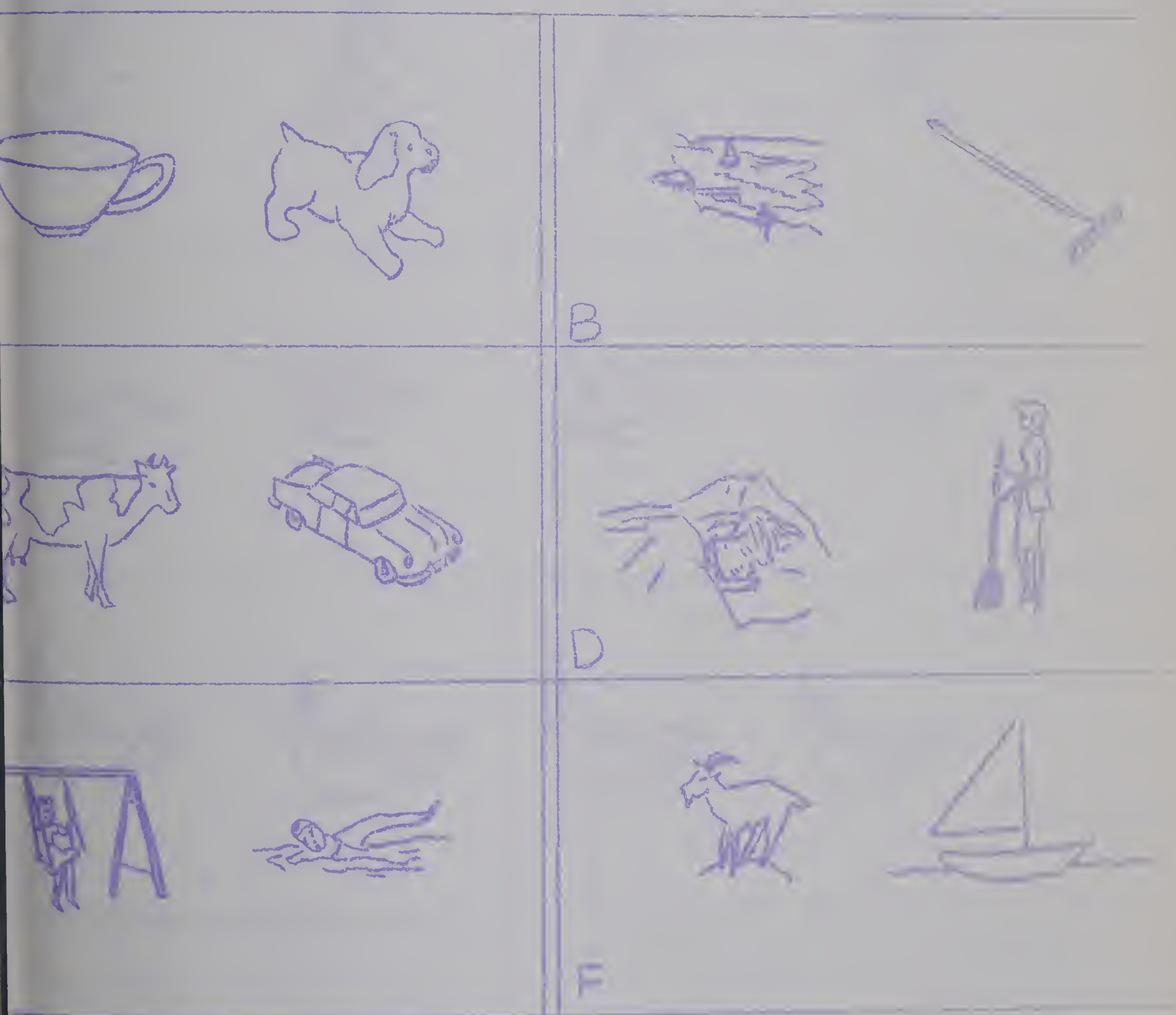
Page Eighteen

A. pair the pear you can eat
the pair of stockings
tail the horse's tail
B. lock the lock you use a key to open
walk the boy who walks
the sidewalk
C. can the can food is stored in
fan the fan you move back and forth
the fan you plug in to start

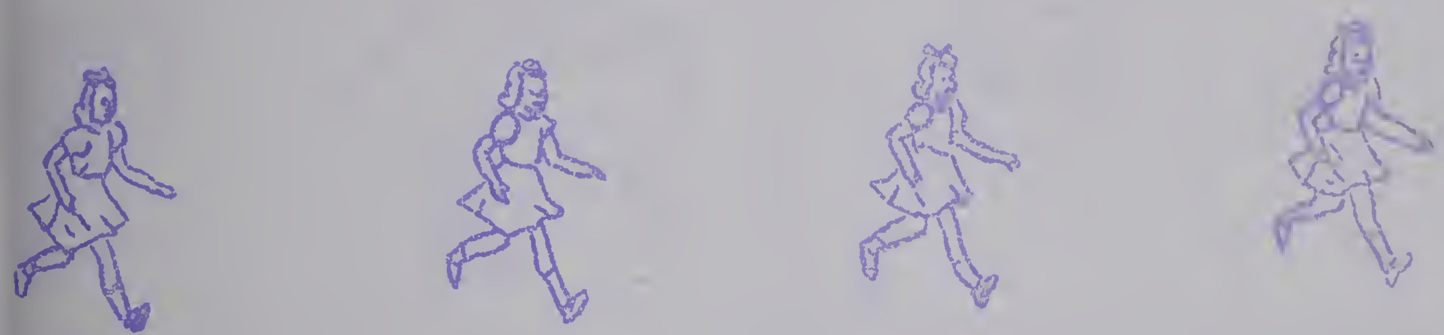
D. falls the boy who falls down
the water falls
call the policeman who calls on the telephone
E. bug the bug with the top hat
jug the jug that can hold water
F. bad the dog that is bad
gag the gag in the boy's mouth

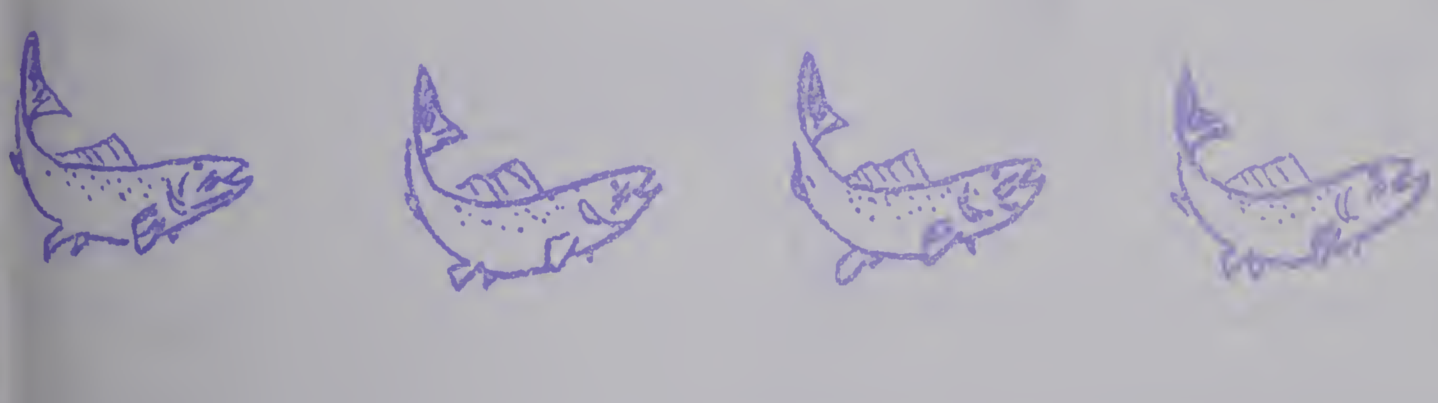
1

Use your ears!



Who will win?





ho won?

e your ears!

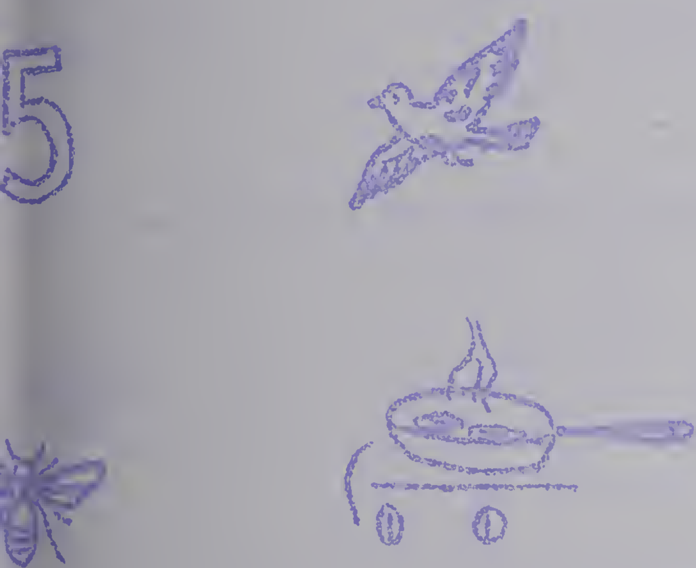
B

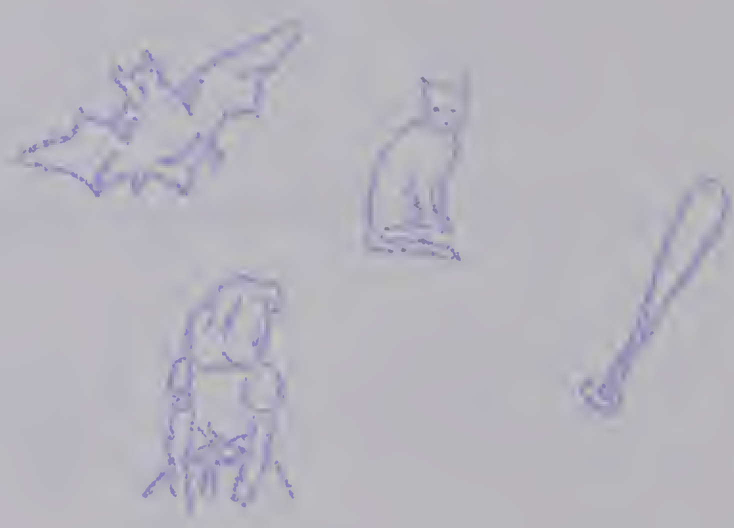
D

F

H

you find them?

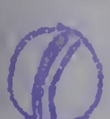




B

D

ay bingo!

B	IN	GO
		
		
		

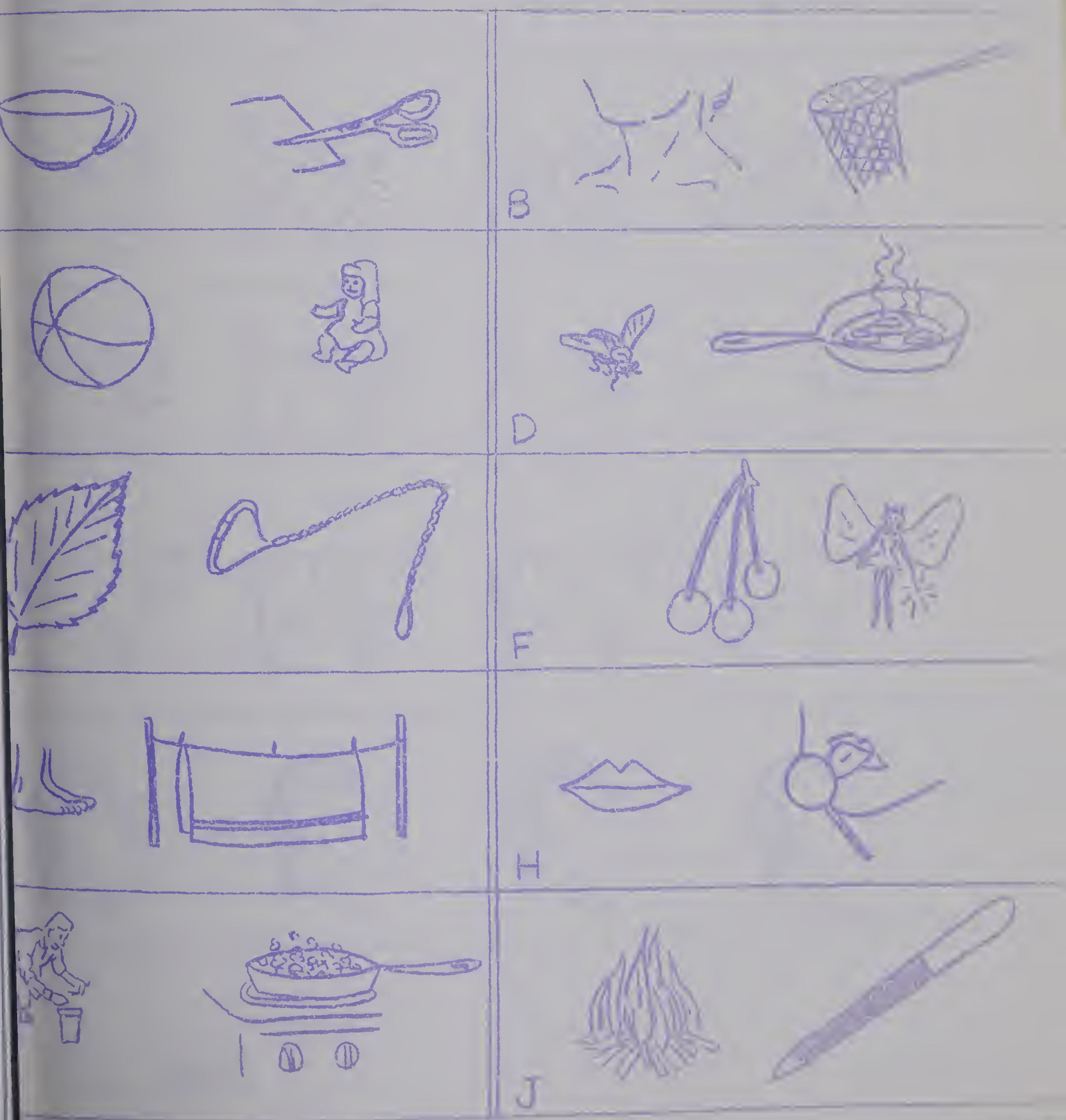
hese are bingos.

	IN	GO

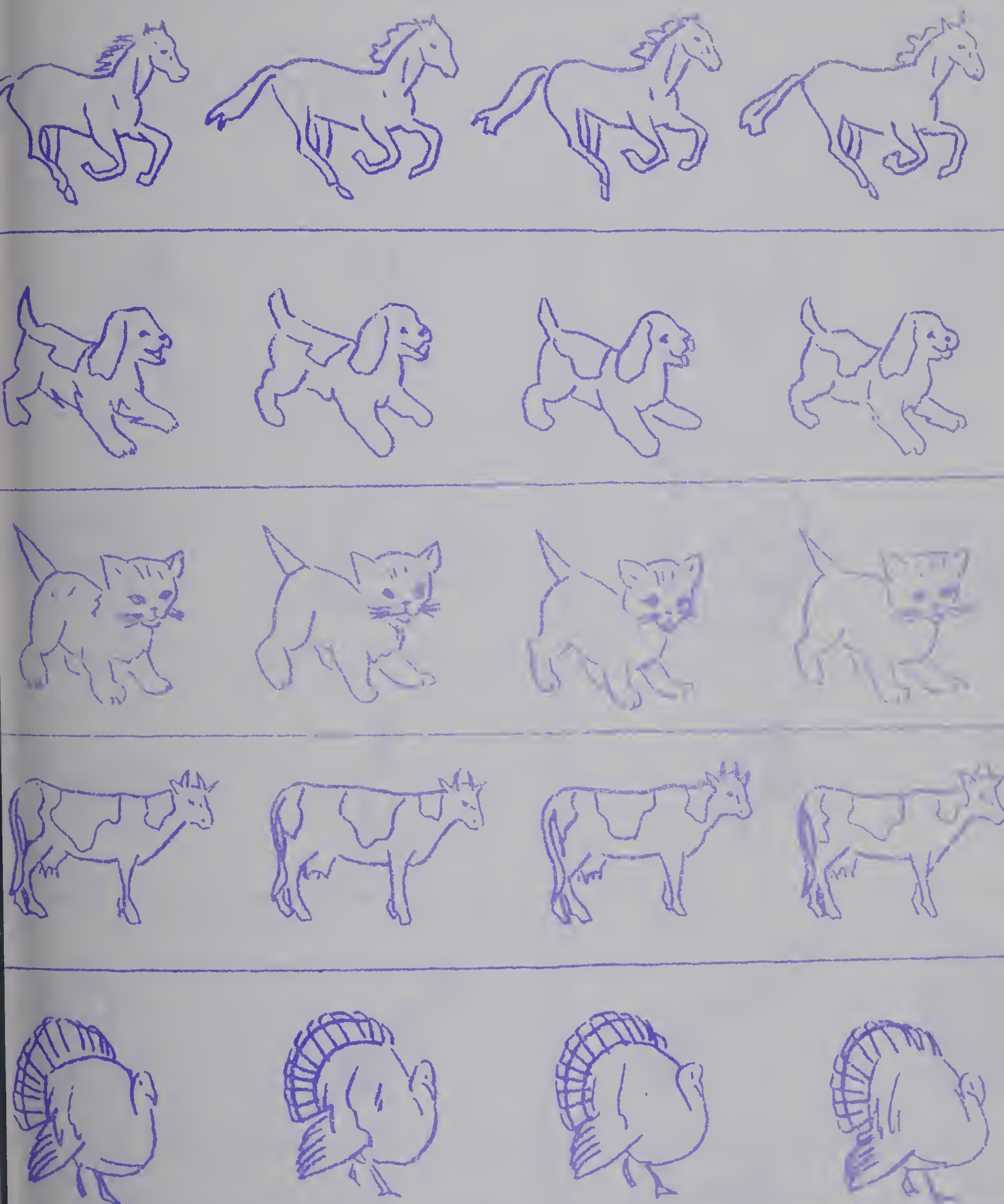
B	IN	GO
X		
	X	
		X

B	IN	GO
X	X	X

Use your ears!

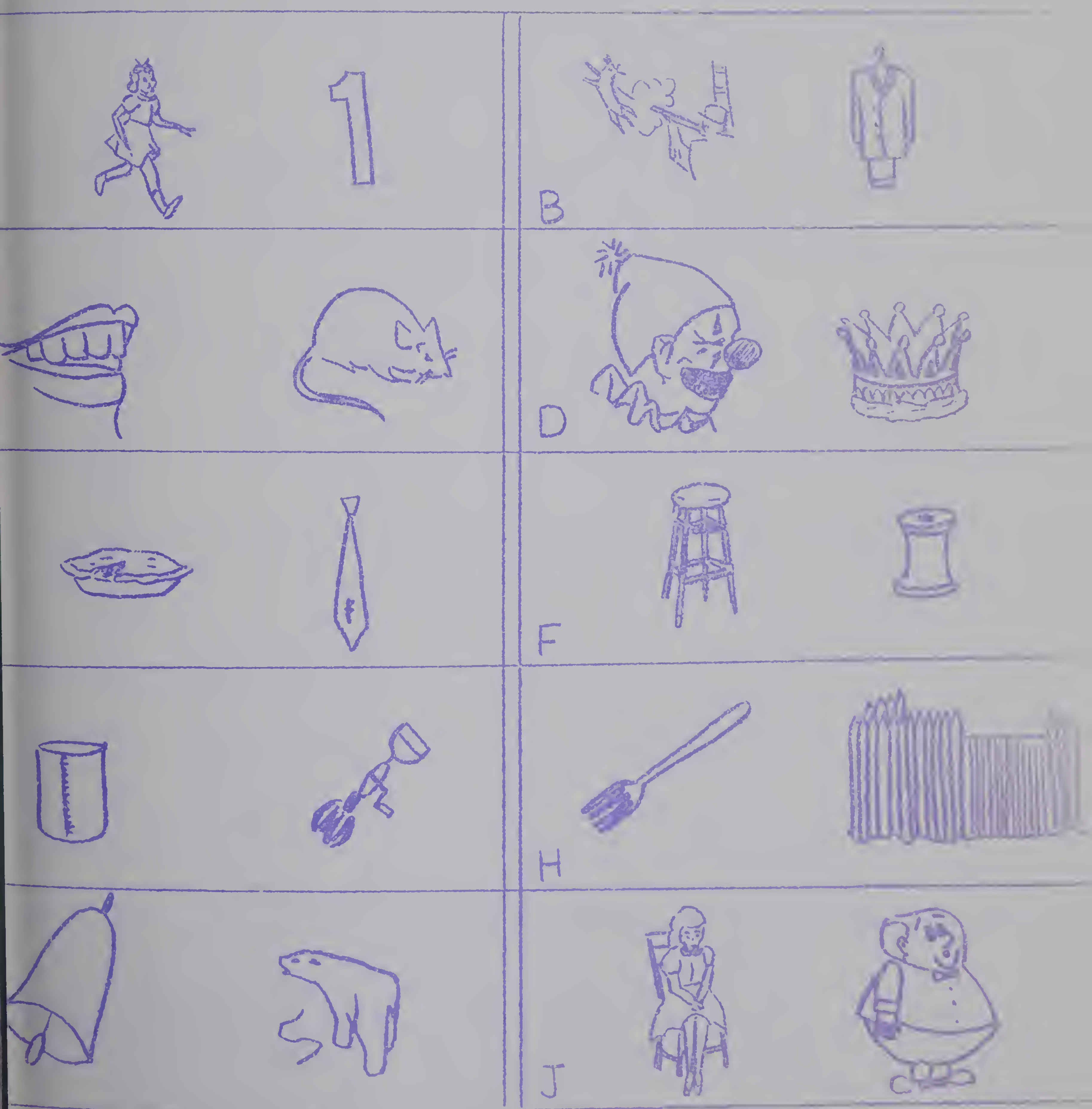


Who will win ?



Who won ?

se your ears!

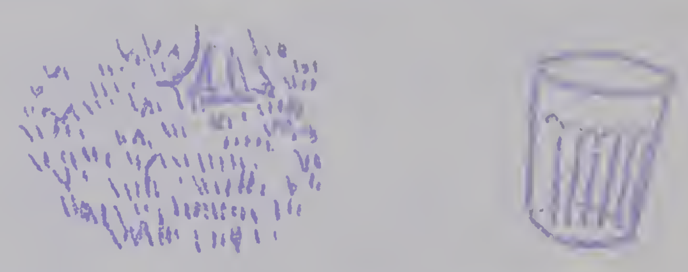


y bingo

B	I	N	G	O

many bingo's did you get? ______________

Use your ears!



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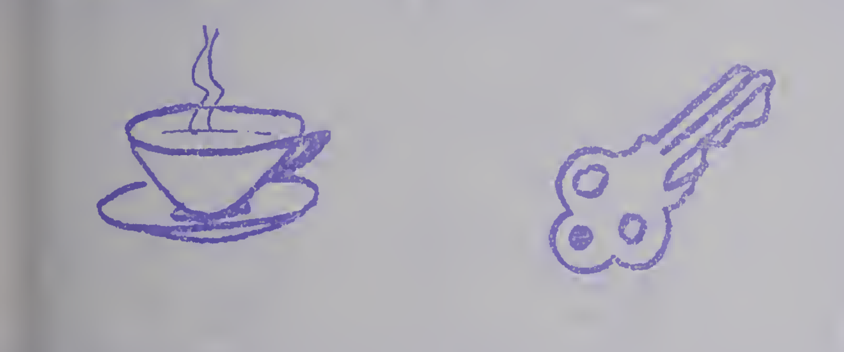
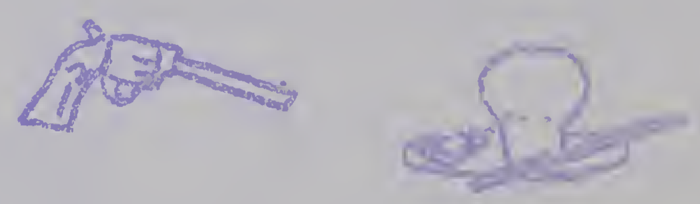




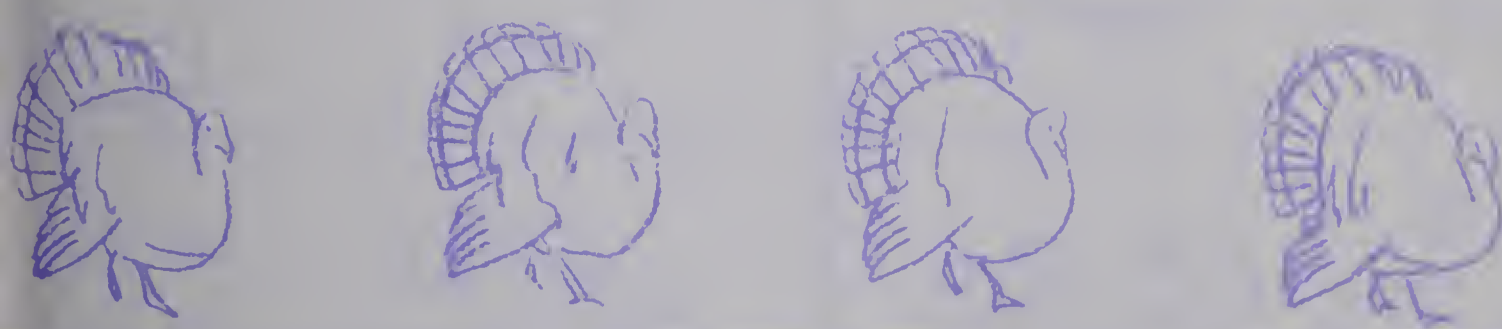
D

F

H

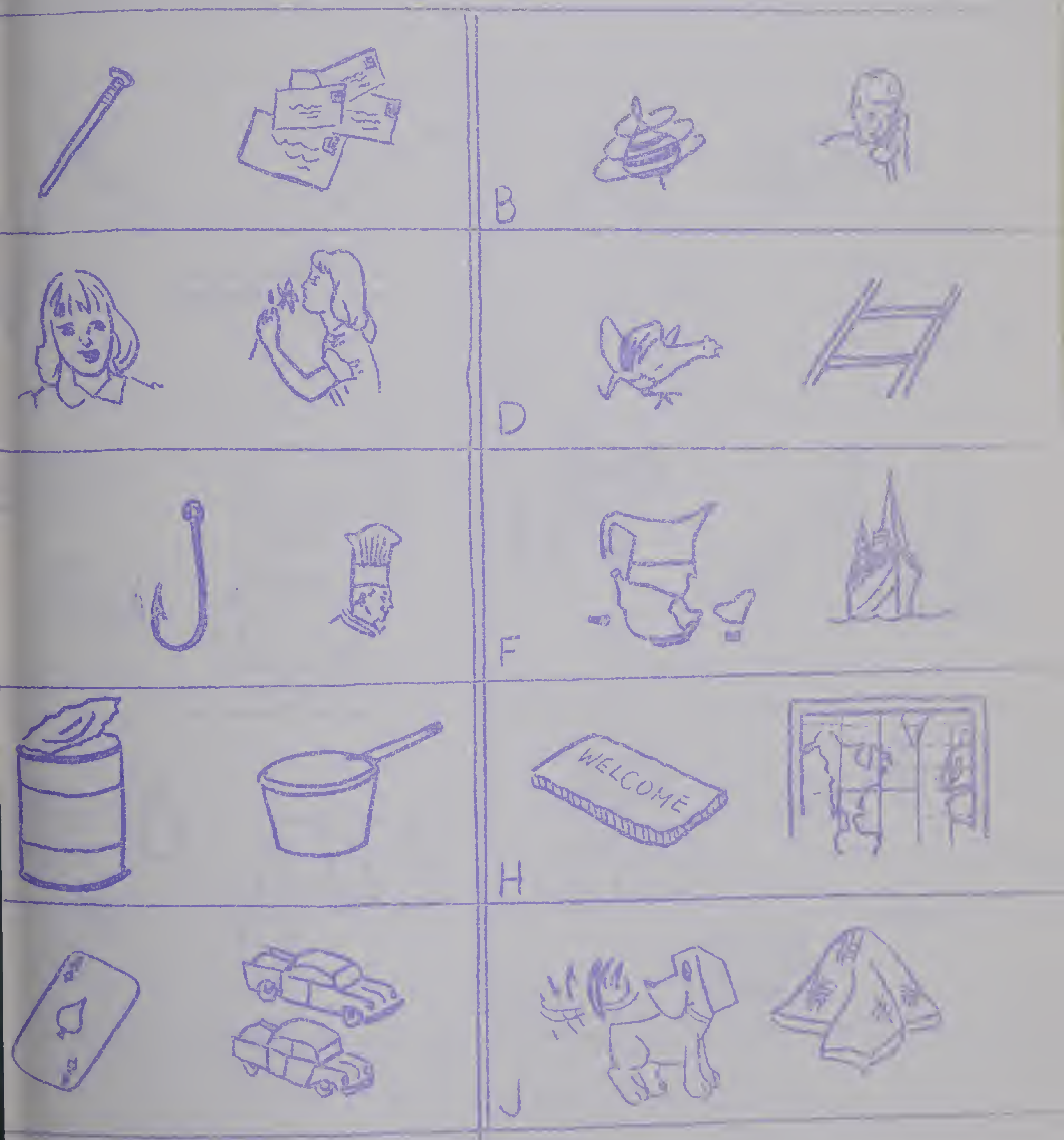
J

Who will win?

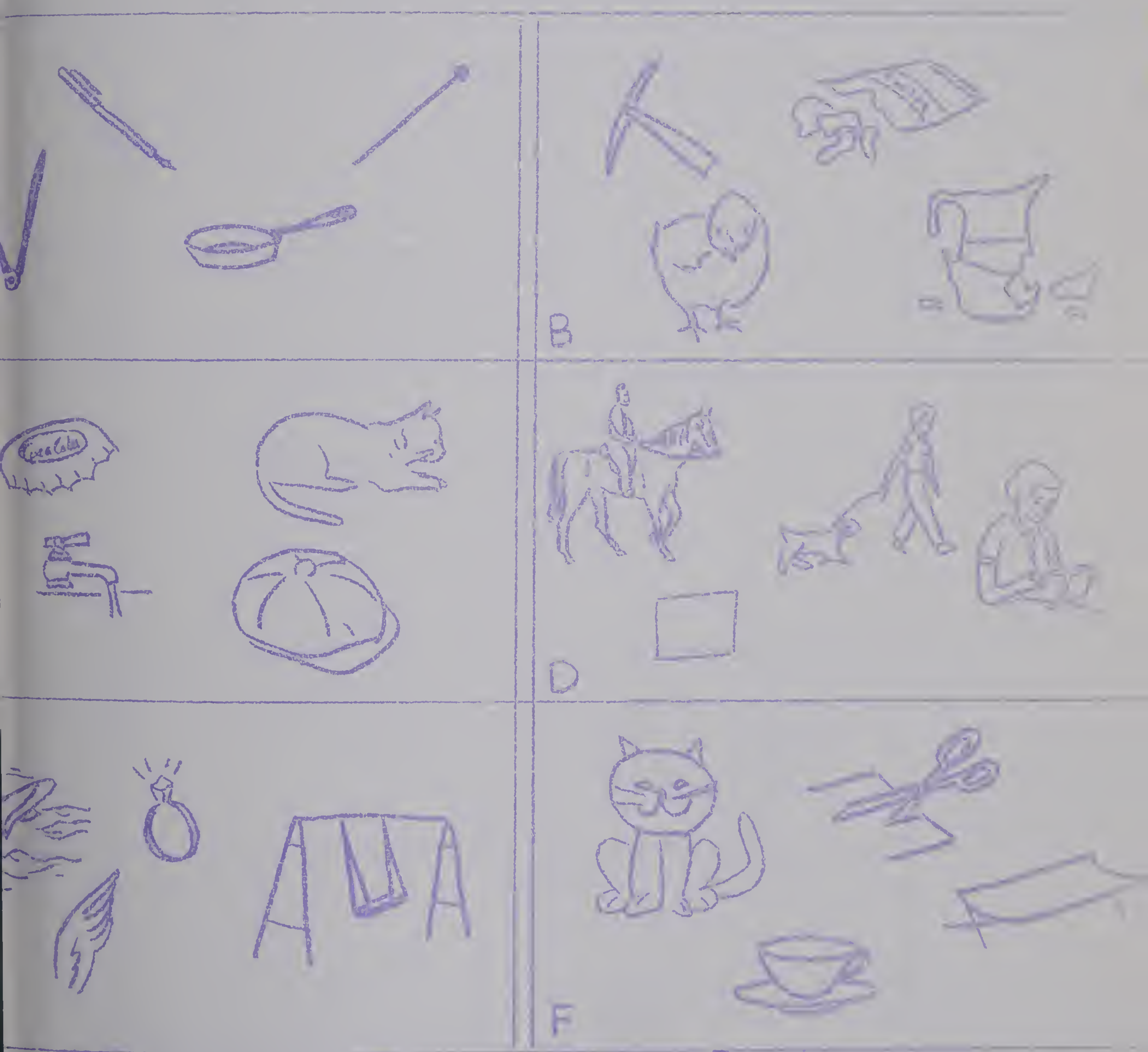


Who won?

Jse your ears!



an you find them all?



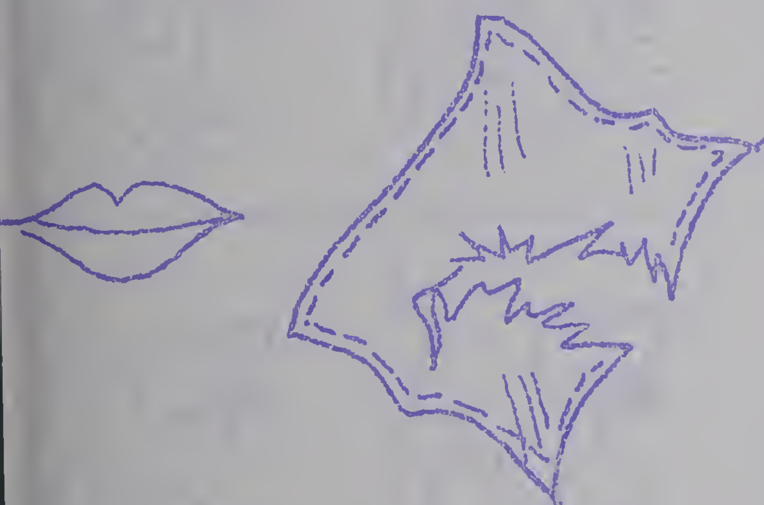
ay bingo!

B	I	N	G	O

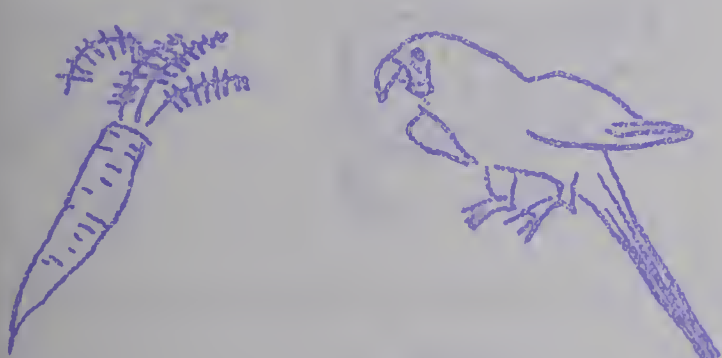
many bingo s did you get? ______

Use your ears! 15

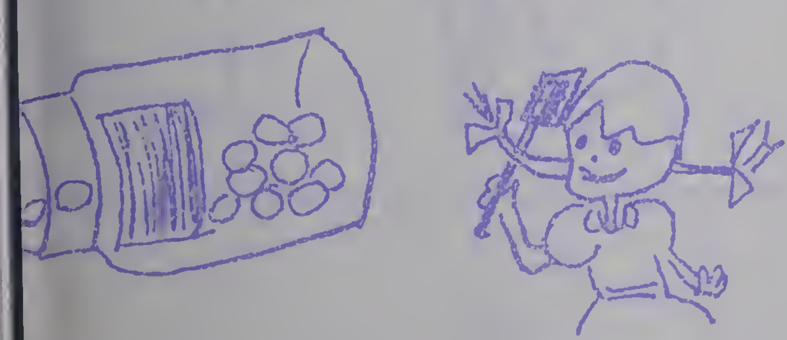
B



D

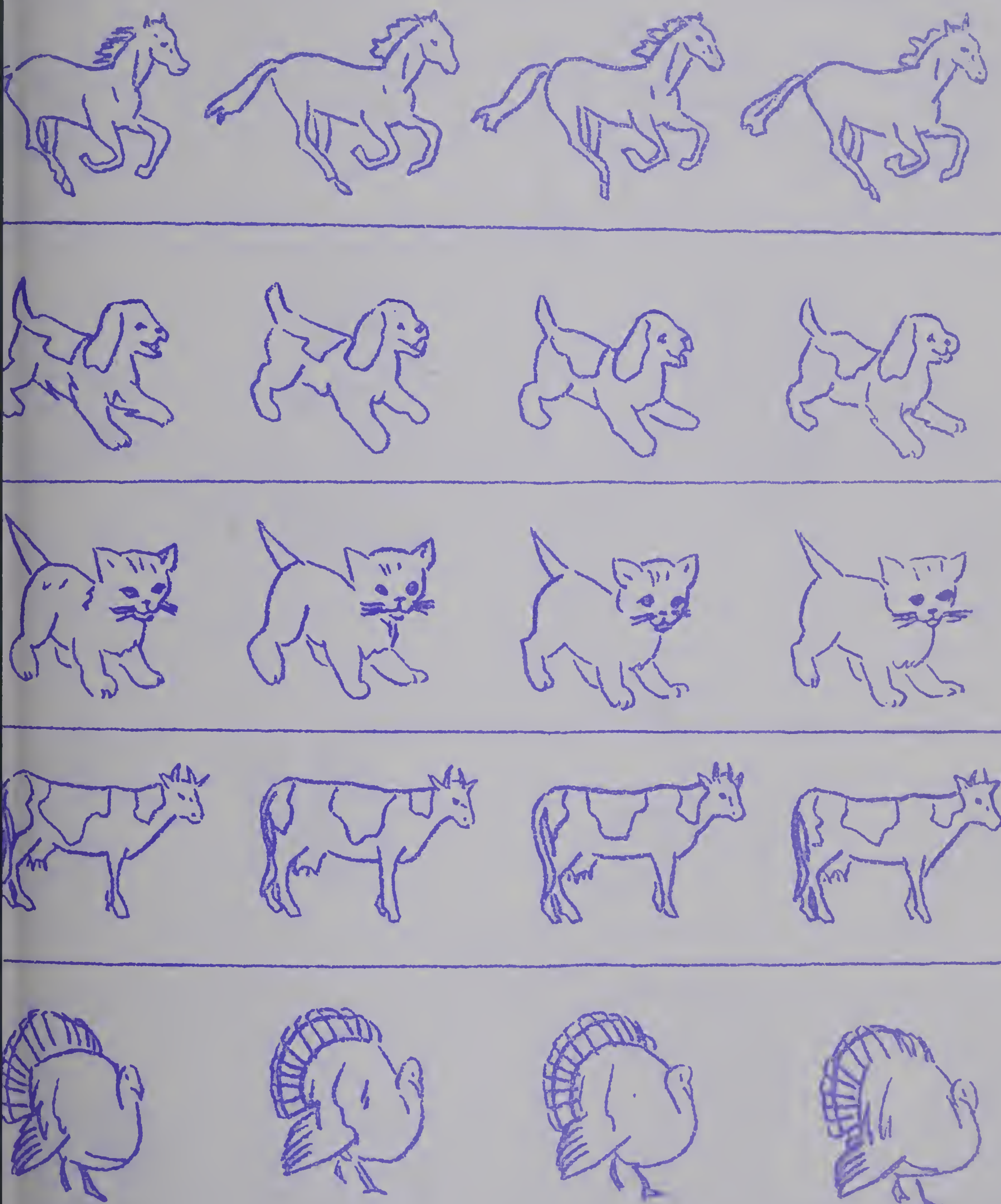


F

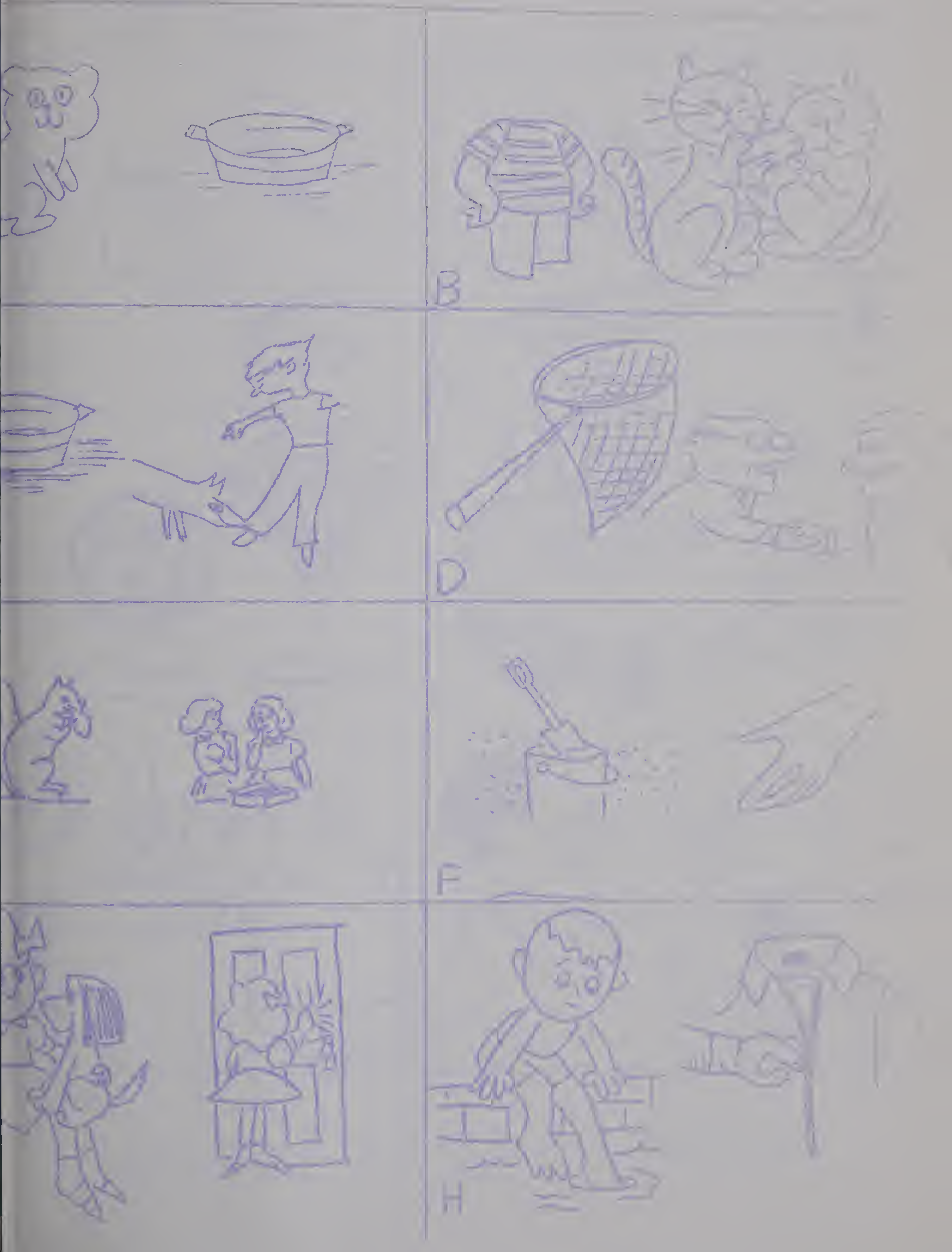


H

Who will win? 16



Who won?


B
D
F
H

you find them?

APPENDIX C:

REGRESSION MODELS TO ASSESS TREATMENT EFFECTS OBTAINED IN THE PRESENCE OF BIAS VARIABLES

I. Introduction

Multiple linear regression models were constructed as outlined by Bottenberg and Ward for testing treatment effects obtained in the presence of possible bias variables.*

II. Vectors for the Models

The following vectors were generated for the construction of the models:

y = the criterion vector of either reading or auditory discrimination scores

x(1) = the group membership vector for the experimental group

x(2) = the group membership vector for the control group

x(3) = pretest scores for corresponding posttest auditory discrimination or reading scores in the vector y

x(4) = a bias variable score for IQ, mental age, chronological age, sex, socio-economic status, or acuity associated with the corresponding score in vector y

x(5) = x(1) * x(4), direct product of vectors x(1) and x(4); it indicates the scores on a bias variable for the experimental group

x(6) = x(2) * x(4), direct product of vectors x(2) and x(4); it indicates the scores on a bias variable for the control group

Bottenberg and Ward recommended that models to test for interactions of treatments and bias variables on criteria scores be constructed first.

III. Models to Test Interaction

The question to be answered by the interaction models was whether or not the amount of change in auditory discrimination or

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*R. A. Bottenberg and J. E. Ward, Applied Multiple Linear Regression (Texas: Medical Division Air Force System Command, Aerospace, March, 1963), Chapter V.

reading scores per unit of change in bias variable was the same for the experimental and control groups. To answer this question two models or linear combinations of vectors were constructed and compared for accuracy in predicting criteria scores.

The full model included information concerning whether subjects belonged to the experimental or the control group; pretest scores for auditory discrimination or reading; and scores on a bias variable for subjects in the control and in the experimental group. The full model was represented by the following linear combination of vectors

$y = a_1x(1) + a_2x(2) + a_3x(3) + a_5x(5) + a_6x(6) + e$ where $a_1 \ldots a_6$ were unknown weights for each vector and e was a residual vector composed of differences between observed and estimated values in vector y

To determine if the difference between the scores of the control and experimental group varied over the range of the bias variable, the restriction $a_5 = a_6$ was imposed on the full model. This restriction simply stated that the change in bias variable for subjects in the experimental group was equal to that for subjects in the control group on auditory discrimination or reading scores. Since $a_5 + a_6$ was equal to the bias variable vector x(4), the restricted model was written as

$$y = a_1x(1) + a_2x(2) + a_3x(3) + a_4x(4) + f$$

The values of the unknown weights for the full and restricted models were the basis for computing the error sums of squares used in evaluating the following F statistic

$$F = \frac{(q_2 - q_1)/df_1}{q_1/df_2}$$

where q_1 is the error sum of squares for $(e_1)^2 + (e_2)^2 \ldots + (e_n)^2$
q_2 is the error sum of squares for $(f_1)^2 + (f_2)^2 \ldots + (f_n)^2$
df_1 is the number of independent predictors in the full model minus the number of independent predictors in the restricted model
df_2 is the number of subjects in the sample minus the number of independent predictors in the full model

If the hypothesis $a_5 = a_6$ was rejected, the difference in the scores of the experimental and control groups was assumed to vary over the range of the bias variable. In order to determine the point at which treatments were equally effective, the following equation given by Bottenberg and Ward was used.

$$a_o = \frac{a_2 - a_1}{a_5 - a_6}$$

IV. Effects of Treatments

Bottenberg and Ward felt that if there was no interaction of treatments and bias variables on criterion scores, a test could be made to ascertain if treatments were equally effective over the entire range of the bias variable. A comparison was again made between two models.

The full model included information concerning whether subjects belonged to the control or the experimental group; pretest scores in auditory discrimination or reading; and scores on a bias variable. The full model was written as

$$y = a_1x(1) + a_2x(2) + a_3x(3) + a_4x(4) + g$$

If the control and experimental groups obtained equal scores, a_1 would be equal to a_2. When the restriction $a_1 = a_2$ was imposed on the full model, the result was

$$y = a_1u + a_3x(3) + a_4x(4) + h$$

since $x(1) + x(2)$ equalled a unit vector for the total group. Again the unknown weights were used to estimate the error sums of squares for the F statistic.

If the hypothesis $a_1 = a_2$ was accepted, the two treatments were assumed to be equally effective. There was no difference between the control and experimental groups on auditory discrimination or reading scores. If $a_1 = a_2$ was rejected, the group for which the predicted value was larger was considered to be superior to the other.

APPENDIX D:

Gray Oral Reading Tests, Forms A and B

Lee-Clark Reading Test, First Reader, Forms A and B.

California Short-Form Test of Mental Maturity, Level 1.

EXAMINER'S RECORD BOOKLET

for the

GRAY ORAL READING TEST

FORM A

Name____________________ Grade________ Age________

School____________________ Teacher________ Sex________

City____________________ State________

Examiner____________________ Date________

SUMMARY

Passage Number	No. of Errors	Time (in Seconds)	Passage Scores	Comprehension
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
Total Passage Scores				
Grade Equivalent				

TYPES OF ERRORS

1.	Aid	
2.	Gross Mispronunciation	
3.	Partial Mispronunciation	
4.	Omission	
5.	Insertion	
6.	Substitution	
7.	Repetition	
8.	Inversion	

OBSERVATIONS
(Check statement and circle each part)

______ Word-by-word reading
______ Poor phrasing
______ Lack of expression
______ Monotonous tone
______ Pitch too high or low; voice too loud, too soft, or strained
______ Poor enunciation
______ Disregard of punctuation
______ Overuse of phonics
______ Little or no method of word analysis
______ Unawareness of errors
______ Head movement
______ Finger pointing
______ Loss of place

COMMENTS:____________________

THE BOBBS-MERRILL COMPANY, INC.
A SUBSIDIARY OF HOWARD W. SAMS & CO., INC.
Publishers • INDIANAPOLIS • NEW YORK

A. 1. Look, Mother, look.
See me go.
I go up.
I come down.
Come here, Mother.
Come and play with me.

Time ____________ Seconds

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Questions	Answers	
__1. What was the girl in this story doing?	Swinging *or* going up and down (1) Showing her mother how she could swing (½)	____________
__2. Who was she talking to?	(Her) Mother (1)	____________
__3. What two things did the girl ask Mother to see her do?	Go up and come down *or* I go up and down (1)	____________
__4. Who was Mother to play with?	The girl (question *her* or *me*) (1)	____________

Number Right ____________

A. 2. A boy said, "Run, little girl.
Run with me to the boat."
They ran and ran.
"This is fun," said the boy.
"Look," said the girl.
"I see something in the boat.
It is my kitten.
She wants to play."

Time ____________ Seconds

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Questions	Answers	
__1. Where did the boy want the girl to run?	To the boat (1)	____________
__2. Who said it was fun to run?	The boy (1)	____________
__3. What was in the boat?	A kitten *or* her kitten (1) Boy's kitten (½)	____________
__4. Who saw the kitten first?	The girl (1)	____________

Number Right ____________

3. One morning a boy made a boat. "Where can I play with it?" he asked.

Father said, "Come with me in the car! We will take your boat with us."

Soon the boy called, "Please stop. I see water. May I play here?"

"Yes," said Father. "Have a good time."

TYPES OF ERRORS	NUMBER
1. Aid	
2 Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

me ________ Seconds

estions	Answers	
1. What did the boy make one morning?	A boat (1)	________
2. What did he say he wanted to do with it?	Play with it (1) Sail it *or* float it, *or* put it in water (½)	________
3. What did the boy see as they rode in the car?	Water (1) Lake (½); pond (½)	________
4. When he saw the water what did he ask his father to do?	Stop *or* stop and let him play (1) Let him play (½)	________

mber Right ________

4. One day five children went out to play in the beautiful white snow. They played for a long time and then began to make snow animals.

One of the animals was a dog. Soon the dog next door came out of the house. When he saw the snow dog he said, "Bow-wow."

The children laughed. "Now we have a dog that can bark."

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

me ________ Seconds

estions	Answers	
1. In what were the children playing?	(Beautiful) (white) snow (1)	________
2. What did they make out of the snow?	(Snow) animals; (1) A dog *or* snow dog (½)	________
3. While they were playing what came out of a house?	A dog (real), (live), (neighbor's), (another) (1)	________
4. What did the children say the real dog could do?	Bark *or* say bow-bow (1)	________

mber Right ________

A. 5. It was pet day at the fair. The children were waiting for the parade of animals to begin. They had trained their pets to do many different tricks. Among them was a tall boy whose goat made trouble for him. It kicked and tried hard to break away. When it heard the band it became quiet. During the parade it danced so well that it won a prize.

TYPES OF ERRORS	NUMBER
1. Aid	
2 Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time __________ Seconds

Questions	Answers	
___1. What day was it at the fair?	Pet (day) (1) Animal (day) *or* animal parade (day) (½)	________
___2. What had the children trained their pets to do?	(To do) (many) (different) tricks (1) Dance *or* do many things (½)	________
___3. What animal made trouble for one boy?	A goat *or* his goat (1)	________
___4. What did the goat do that won a prize?	Danced (in the parade) (1)	________

Number Right __________

A. 6. Airplane pilots have many important jobs. They fly passengers, freight, and mail from one city to another. Sometimes they make dangerous rescues in land and sea accidents, and drop food where people or herds are starving. They bring strange animals from dense jungles to our zoos. They also serve as traffic police and spot speeding cars on highways.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time __________ Seconds

Questions	Answers	
___1. Whom is this paragraph about?	Airplane pilots (1) Airplane pilot (½), pilots (½) Airplane driver (½)	________
___2. What do they take from city to city?	Passengers, mail, freight (any two of these) (1) Mail *or* freight *or* animals and food (½) Passengers and food (½)	________
___3. What kind of rescues are sometimes made in land and sea accidents?	Dangerous (1)	________
___4. What do airplane pilots do when serving as traffic police?	Look for (*or* spot) speeding cars (1) Track (*or* stop) speeding cars (½) Stop cars (0)	________

Number Right __________

A. 7. Hundreds of years ago, most of Europe was a very poor region. But China, a large country in eastern Asia, had many of the comforts of a rich civilized nation. Only a few people from Europe had visited this distant region. One was the famous Marco Polo. He learned some of the languages that were spoken in China and served its great ruler for many years.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ____________ Seconds

Questions	Answers	
__1. What kind of region was most of Europe hundreds of years ago?	(Very) poor (1)	____________
__2. What country enjoyed far more comforts than Europe?	China (1)	____________
__3. Who was one of the few people from Europe who visited China?	Marco Polo (1) Marco (½), Polo (½)	____________
__4. What did Marco Polo learn in China?	Some *or* a few of the languages (1) The language (½) Many of (*or* the) languages of China (½) Different languages (½)	____________

Number Right ____________

A. 8. The eager spectators who had cheered the plucky Warriors through eight hard-fought innings were silent. Only a run was required to defeat the much feared Champions, who had previously defeated all opponents. The spectators had earlier criticized the umpire severely. Now their faces were tense with excitement as the players took their positions.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ____________ Seconds

Questions	Answers	
__1. How had the spectators encouraged the plucky Warriors?	(By) cheering *or* cheered (1)	____________
__2. How many runs were needed to defeat the Champions?	One *or* a run (1)	____________
__3. Whom had the spectators criticized early in the game?	The umpire (1)	____________
__4. How did the faces of the spectators look as the players took their positions?	Tense (with excitement) *or* sullen (1) Serious (½)	____________

Number Right ____________

A. 9. The oil industry has been greatly increased by recent advances in science. Geologists have discovered new ways of locating veins of oil-producing rock. Problems of gusher control have been solved. Very effective also are newer methods of refining crude oil which have resulted in a higher ratio of quality fuel oil from a given volume of crude oil.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ________ Seconds

Questions	Answers	
___1. What industry does this paragraph discuss?	Oil (industry) *or* petroleum (industry) (1)	________
___2. What kind of rock have geologists found new ways of locating?	Oil producing (rock) (1)	________
___3. For what purpose have new and effective methods been developed?	To refine crude oil *or* change crude oil to good oil (1)	________
___4. What has been the result of the use of the newer methods of refining crude oil?	More fuel *or* quality oil from crude oil; *or* higher ratio of quality oil (1) More oil (½) Better oil than at first (½)	________

Number Right ________

A. 10. In response to the impulse of habit Joseph rose and spoke as in former days. He spoke vigorously, continuously, and persuasively while the others listened attentively but in grim and contemptuous silence. Finally exhausted, Joseph hesitated for a moment; as often happens in such circumstances he became confused and was unable to resume speaking.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ________ Seconds

Questions	Answers	
___1. To what impulse did Joseph respond when he rose to speak?	Habit (1) Used to it (½), *or* natural (½)	________
___2. In what manner did he speak?	Vigorously, continuously, persuasively (any two) (1) Persuasively, persistently, consistently (½); vigorously and intently (½)	________
___3. How did the others listen?	Attentively and in (contemptuous) silence (1) Attentively (½), contemptuously (½), quietly (½), closely (½), in silence (½)	________
___4. After Joseph became exhausted, why was he unable to resume speaking?	He was *or* became confused (1) Flustered (½)	________

Number Right ________

A. 11. Many of the hypotheses about physical phenomena formulated by early philosophers were inconsistent and in most cases could not be universally applied. In order to develop accurate principles very capable physicists, mathematicians, and statisticians had to cooperate wholeheartedly over long periods of time to verify numerous basic facts and assumptions.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ________ Seconds

Questions	Answers	
1. Name one limitation of the hypotheses about physical phenomena that was formulated by early philosophers.	Inconsistent *or* not universally applicable (1)	________
2. The cooperation of what specialists was needed in developing more accurate principles?	Physicists, mathematicians, statisticians (1) Mathematicians, Physicists, Philosophers (½) Mathematicians, Philosophers (½)	________
3. To develop more accurate principles what was the chief thing they had to do?	Verify (many *or* numerous) (basic) facts *or* assumptions (1) Cooperate wholeheartedly (½)	________
4. In what manner did they cooperate to achieve their goal?	Wholeheartedly (1)	________

Number Right ________

A. 12. In a concluding lecture on sidereal (sī dēr′ê ăl) spaces, the astronomer contrasted the infinitesimal (ĭn′fĭn ĭ tĕs′ ĭ măl) difference in the distance of the moon from the earth at apogee (ăp′ô jē) and at perigee (pĕr′ĭ jē) with the great difference in the distance of the earth from the sun at aphelion (ă fē′lĭ ŏn; —fēl′yŏn) and at perihelion (pĕr′ĭ hē′lĭ ŏn). The students interrogated (ĭn tĕr′ô gāt′ĕd) him, evidencing precociousness (prê kō′shŭs nĕs) and lucidity (lû sĭd′ĭ tĭ) in expression.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ________ Seconds

Questions	Answers	
1. What kind of specialist was giving the lecture?	An astronomer (1)	________
2. What was the general topic of the lecture?	Sidereal *or* starry spaces (1) Space (½)	________
3. Apogee and perigee refer to distances between the earth and what other heavenly body?	Moon (1)	________
4. What did the students do that showed unusual brightness and lucidity in expression?	Interrogated *or* questioned the lecturer; asked (lucid *or* clear) questions (1)	________

Number Right ________

A. 13. During a hiatus (hī ā′tŭs) in the desultory (dĕs′ŭl tō′rĭ; esp. British . . . tĕr i) firing, the apt lieutenant clambered wearily over the detritus (dē trī′tŭs) piled against the redoubts (rē douts′). Beneath a canopy of empyrean (ĕm′pĭ rē′ăn; ĕm′pī rē′ . . .) blue lay the quiet, bucolic (bū-kŏl′ĭk) landscape, its pristine (prĭs′tēn; . . . tĭn) beauty now defiled by myriad (mĭr′ĭ ăd) diminutive (dĭ mĭn′ū tĭv) promontories thrown up by the mortar shells, but radiating momentarily an inexplicable (ĭn ĕks′plĭ kȧ b'l) if spurious (spū′ rĭ ŭs) calm and peace.

TYPES OF ERRORS	NUMBER
1. Aid	
2 Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ______ Seconds

Questions	Answers	
___1. When did the lieutenant crawl over the detritus?	During the hiatus *or* gap *or* lull in the firing (1) When it was quiet (½) After the firing (½)	______
___2. What was the color of the sky?	Empyrean *or* heavenly blue (1) Blue (½)	______
___3. What marred the beauty of the landscape?	Diminutive *or* (very) small promontories *or* mounds (1)	______
___4. By what had these promontories been made?	Mortar shells (1)	______

Number Right ______

EXAMINER'S RECORD BOOKLET

for the

GRAY ORAL READING TEST

FORM B

ame____ Grade____________ Age____________

chool____ Teacher____________ Sex____________

ity____ State________________________

xaminer____ Date________________________

SUMMARY

Pas-sage Number	No. of Errors	Time (in Seconds)	Pas-sage Scores	Compre-hension
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
Total Passage Scores				
Grade Equivalent				

TYPES OF ERRORS

1.	Aid	
2.	Gross Mispronunciation	
3.	Partial Mispronunciation	
4.	Omission	
5.	Insertion	
6.	Substitution	
7.	Repetition	
8.	Inversion	

OBSERVATIONS

(Check statement and circle each part)

________ Word-by-word reading
________ Poor phrasing
________ Lack of expression
________ Monotonous tone
________ Pitch too high or low; voice too loud, too soft, or strained
________ Poor enunciation
________ Disregard of punctuation
________ Overuse of phonics
________ Little or no method of word analysis
________ Unawareness of errors
________ Head movement
________ Finger pointing
________ Loss of place

COMMENTS:____

THE BOBBS-MERRILL COMPANY, INC.
A SUBSIDIARY OF HOWARD W. SAMS & CO., INC.
Publishers • INDIANAPOLIS • NEW YORK

B. 1. Look, Father.
See the ball.
I want you to play.
We can play ball here.
Come, Father.
Play ball with me.

Time __________ Seconds

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Questions	Answers	
__1. Who was the boy talking to?	Father (1)	______
__2. What did the boy want his father to see?	The ball (1) Ball and bat (½)	______
__3. What did the boy want to do?	Play (base)ball with Father (1) Play (½)	______
__4. How many were to play ball?	Two (1)	______

Number Right__________

B. 2. A girl ran to the house.
"Mother," she said.
"I want something to eat."
Mother said, "See what I have for you.
You will like it."
"Thank you," said the girl.
"This is very good.
Where may I eat it?"

Time __________ Seconds

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Questions	Answers	
__1. Who ran to the house?	(A) girl (1)	______
__2. Who did she speak to?	Mother (1)	______
__3. What did she ask for?	Something to eat *or* food (1)	______
__4. What did she say about the food?	This *or* it is good (1)	______

Number Right__________

B. 3. A boy had a wagon. He ran with it to a store. Soon he came back with a box. He called his dog and said, "Jump in, Happy. This is your home."
In the morning the boy had a surprise. Happy was not in the box. Three kittens were there.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time __________ Seconds

Questions	Answers	
__1. Where did the boy go with his wagon?	(To the) store (1)	__________
__2. What did he get at the store?	(A) box (1)	__________
__3. Who did he get the box for?	Happy *or* his dog (1)	__________
__4. What was in the box the next morning?	(Three) kittens (1)	__________

Number Right__________

B. 4. A little girl ran out of a white house into a big yard. "Mother," she said, "my pet bird is gone. It went out of the open window."
Mother laughed and said, "Look on my hat." When the girl looked she had a big surprise. A yellow bird with blue wings was on Mother's pretty hat. It was the bird that flew away.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time __________ Seconds

Questions	Answers	
__1. Who was the girl talking to in this story?	Mother (1)	__________
__2. What had the girl lost?	(Her) (pet) bird (1)	__________
__3. When the girl saw her bird where was it sitting?	(On) Mother's (pretty) hat (1) (On) Mother's yellow hat (½) (On) yellow hat (½)	__________
__4. What was the color of the bird's wings?	Blue (1) Blue and yellow (½)	__________

Number Right__________

B. 5. Twelve boys were waiting in line at a party to play a game. A picture of a lion hung on the wall before them. They first put large paper bags over their heads so they couldn't see. Each of the boys then tried to pin a ribbon on the lion's tail. They put ribbons on the lion's legs, head, and body. All missed its tail. So none of them won the prize.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ________ Seconds

Questions	Answers	
___1. What were the boys waiting in line to play?	(A) game (1)	________
___2. A picture of what animal hung on the wall?	(A) lion (1)	________
___3. What did the boys put over their faces so they couldn't see?	(Paper) bags (1) A bag (½)	________
___4. On what part of the lion did they try to pin the ribbon?	On the lion's tail (1)	________

Number Right________

B. 6. One morning a big poster outside of Oak School told people about a basement bargain sale. Inside were long counters on which things collected by the children were displayed. Price tags were fastened to all articles. Most of the customers bought old but useful furniture. The sale was a huge success, and the money was used to purchase library books.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ________ Seconds

Questions	Answers	
___1. What was going on in the basement of Oak School?	(Bargain) sale *or* selling things *or* rummage sale (1)	________
___2. Who had collected the things for the sale?	Children; *or* boys and girls of Oak School (1) Children and grown ups (½)	________
___3. On what were the things displayed?	(Long) counters *or* long tables (1) Tables (½)	________
___4. What was purchased with the money that was made?	Library books *or* books for the library (½) New (*or* school) books (½)	________

Number Right________

B. 7. All of us admire the great skill of a good truck driver. He hauls many tons of things almost daily, including dangerous explosives. On mountain roads and in other isolated places he faces real dangers alone. He is his own mechanic. Sturdy and dependable, he will interrupt his schedule to help anyone who encounters real difficulty on a highway.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ____________ Seconds

Questions	Answers	
___1. About whom is this paragraph?	Truck driver (1)	____________
___2. What does he haul that makes his trips dangerous?	Explosives (1)	____________
___3. On what kind of roads does he face real dangers alone?	Mountain *or* isolated roads (1) Lonely roads (½)	____________
___4. For what purpose does he often interrupt his schedule?	To help people in difficulty (1)	____________

Number Right____________

B. 8. Rocky portions of the earth's surface are always changing. Many huge glaciers in the mountains carry along immense boulders which crush the rocks beneath. Chemicals in many streams penetrate rocks and dissolve them. Rocky surfaces are also broken up by processes of freezing and thawing which occur in most regions of alternate hot and cold weather.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ____________ Seconds

Questions	Answers	
___1. Which portions of the earth's surface are always changing?	Rocky parts *or* rocky *or* rock surfaces (1) Rocks *or* rocky bases (½)	____________
___2. What are found in glaciers that crush the rocks beneath them?	(Huge) boulders (1) Loose rocks (½) stones (0)	____________
___3. What is found in streams that help to dissolve rocks?	(Penetrating) chemicals (1)	____________
___4. What processes produced by the weather break up rocky surfaces?	Freezing and thawing (1) Heat and cold (½)	____________

Number Right____________

B. 9. After the American Revolution the colonies became states, each one having a governor. What was urgently needed was a federal government to insure domestic peace and to protect citizens from enemy attack. A constitutional convention was convened. After heated controversy, a constitution was prepared and submitted to the states for approval.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ________ Seconds

Questions	Answers	
___1. When did the American colonies become states?	After the (American) Revolution *or* the Revolutionary War (1) After war (½)	________
___2. What was needed to protect citizens from enemy attacks?	Efficient *or* strong (federal) government *or* powerful government *or* federal government (1)	________
___3. Who attended the assembly that was held?	(States) delegates *or* representatives (1)	________
___4. What did the state delegates prepare when they assembled?	Constitution (1)	________

Number Right________

B. 10. Beside the fireplace with its polished fixtures was a mohair chair which was in sharp contrast (kŏn′trăst) with a brilliant cover on a near-by footstool. Against the opposite wall stood a desk with stationery protruding from all its pigeonholes. But the object to which Alice's eyes returned repeatedly was a large flagon of incomparable (ĭn kŏm′pȧ rȧ b'l) value and startling beauty.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time ________ Seconds

Questions	Answers	
___1. Where was the mohair chair located?	Beside *or* near by *or* next to the fireplace (1)	________
___2. In what part of the desk was the stationery kept?	Pigeonholes (1)	________
___3. What was the object that most attracted Alice's attention?	A flagon (1)	________
___4. What were the two characteristics of the flagon?	Value and beauty *or* Valuable and beautiful *or* Priceless and beautiful (1)	________

Number Right________

. 11. The visage (vĭz′ĭj) of the pontiff was a familiar sight amidst the ornate decorations of the court. Famous for his politeness, he was as familiar with worldly affairs as with theology—a master strategist (străt′ê jĭst) who could mold saints and sinners into a unified group or, if the situation justified such steps, discountenance unregenerates with a single quiet reproof.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

ime __________ Seconds

uestions	Answers	
1. Who was a familiar sight at the Court?	A pontiff (1)	______
2. In what two fields was he equally familiar?	Worldly *or* secular *or* temporal affairs and theology *or* religion (1)	______
3. What two groups could he mold into one unified group?	Saints and sinners (1) Good and bad (½)	______
4. How did he discountenance unbelievers?	By (single) (quiet) reproof (1) By a single word *or* glance (½)	______

umber Right__________

. 12. An immediate rejection of customary rituals was unlikely as cultists steeped in traditional tribal lore advocated propitiation (prô pĭsh′ĭ ā′shŭn) of imaginary deities. Their stubborn opposition to the abandonment of paganism subsequently brought opprobrium (ŏ prō′brĭ ŭm) upon them, and historians record a cessation of eleemosynary (ĕl ê mŏs′ĭ nĕr ĭ) enterprises until such customs were discontinued.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

ime __________ Seconds

uestions	Answers	
1. What were the cultists not likely to renounce?	Their customary *or* usual rituals (1) Rituals (½) Customs (½)	______
2. What did they want to propitiate or appease?	Imaginary deities (1)	______
3. What did the cultists bring upon themselves by their unwillingness to abandon paganism?	Opprobrium *or* reproach *or* disgrace *or* contempt (1)	______
4. What type of enterprise ceased as long as paganism was practiced?	Eleemosynary *or* charitable (1)	______

umber Right__________

B. 13. The ophthalmologist (ŏf′thăl mŏl′ô jĭst) sent cultures to the microscopist (mi krŏs′kô pĭst) requesting his opinion as to the causative (kôz′ȧ tĭv) organism (ôr′găn ĭz’m) of a painful conjunctivitis (kŏn jŭngk′tĭ vī′tĭs). A delay resulted when the expert on microscopy (mi-krŏs′kô pĭ) consulted the histomorphologist (hĭs′tô môr fŏl′ô jĭst) before giving a report. Meanwhile an anodyne (ăn′ô dīn) was prescribed to forestall a recurrence (rê kŭr′ĕns) of the patient's unfortunate sharp painful attacks.

TYPES OF ERRORS	NUMBER
1. Aid	
2. Gross Mispronunciation	
3. Partial Mispronunciation	
4. Omission	
5. Insertion	
6. Substitution	
7. Repetition	
8. Inversion	
Total Errors	

Time __________ Seconds

Questions	Answers	
__1. To whom did the ophthalmologist send cultures?	Microscopist (1)	__________
__2. What was the microscopist asked to find?	Causative organism *or* organism causing trouble *or* pain *or* disease (1) What was the trouble *or* wrong (½) Cause of the painful attacks (½)	__________
__3. With what disease was the patient afflicted?	Conjunctivitis (1)	__________
__4. Why was an anodyne prescribed?	To prevent a recurrence of the painful attacks; to forestall more pain (1) To stop the pain *or* to give relief to the patient *or* to allay sharp pain (½)	__________

Number Right__________

First Reader • GRADES 1 and 2 • Form A

Lee-Clark Reading Test

1958 REVISION

DEVISED BY J. MURRAY LEE AND WILLIS W. CLARK

15th Printing

UBLISHED BY CALIFORNIA TEST BUREAU, DEL MONTE RESEARCH PARK, MONTEREY, CALIFORNIA
RANCH OFFICES: NEW CUMBERLAND, PA.; MADISON, WIS.; DALLAS, TEXAS –

PART 1

	boy	girl	the	at
	try	how	an	ears
1.	let	cat	roll	open
2.	coat	rat	please	great
3.	pink	green	black	red
4.	again	another	ate	about
5.	hide	hid	hill	here
6.	stamp	store	shelf	seeds
7.	bird	flower	much	many
8.	grow	grew	blow	flew
9.	cotton	cents	churn	cloth
10.	warm	while	weeks	wise
11.	twelve	ten	three	two
12.	hand	hungry	hurry	hurt
13.	barked	turned	washed	sorted
14.	sometimes	animals	anything	something
15.	postmaster	playground	postman	package

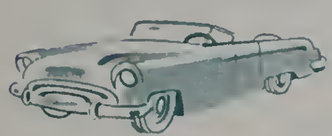
Part 1 Score (number right) ....

PART 2

boy

girl

10



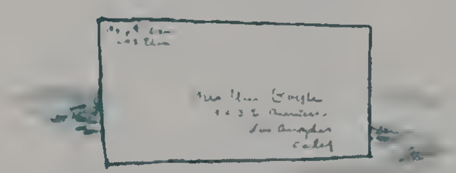
1. bird
2. flower
3. ten
4. cap
5. shoes
6. nose
7. window
8. feathers
9. duck
10. calves
11. automobile
12. tree
13. jump
14. blows
15. swim

Part 2 Score
(number right)

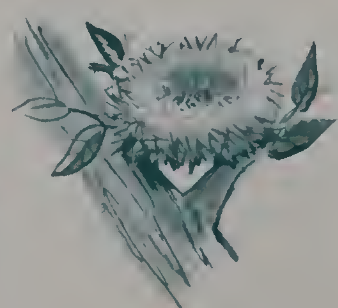

Make an **X** on the boy.

Make an **O** on the girl.


1. Make an **X** on the slide.
2. Make an **O** on the teeter-totter.

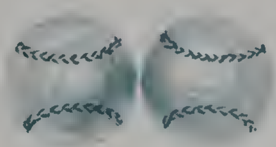



3. Draw a stamp on the letter.
4. Draw a line under the package.

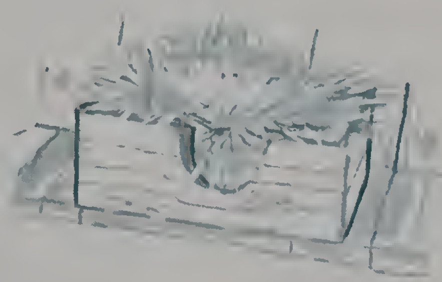




5. Draw a line from the robin to the nest.
6. Draw an egg in the grass.

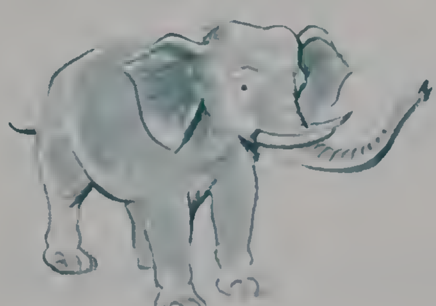
7. Put an **X** on the block that has **Y** on it.
8. Put an **X** on the squirrel's feet.

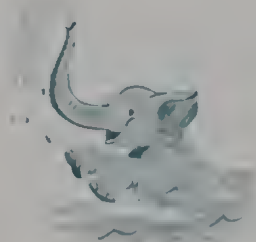


9. Draw a line under the three eggs.



10. Draw a line under the hen that is on the nest.





11. Put an **X** on the small elephant.
12. Put an **O** on the elephant *not* in the water.

Part 3 Score (number right)

The dog sat on the

showed. **steps.** **other.**

1. The man carried the

    stamped. **sorted.** **mail.**

2. Donald had a dream about

    never. **pirates.** **first.**

3. The kitty rolled and slid on the

    floor. **once.** **taste.**

4. The wise old rat knew about

    listened. **dead.** **traps.**

5. The pigs squealed for their

    churn. **curly.** **supper.**

6. The farmer planted the little

    fight. **threw.** **seed.**

7. The elephants live in the

    last. **jungle.** **banana.**

8. The little elephant will need to hold his trunk out of the

    water. **tired.** **near.**

9. The little yellow duck likes to eat

    worms. **strong.** **brook.**

Part 4 Score (number right)

PART 5

1. Jack and Sue made a snow man.
   The snow man was
   red. **white.** **black.**

2. Mother Robin carried sticks and grass.
   She made
   a nest. **the mud.** **a song.**

3. Jack went to the toy store.
   He liked the
   milk. **snow man.** **toy soldiers.**

4. The toys came to the party.
   The big dolls said,
   "Ma-ma." **"Choo-choo."** **"Bow-wow."**

5. When the cat ran away,
   the mice were
   sick. **happy.** **afraid.**

6. Jack and Donald hid in the hay.
   Sue and the dog
   planted. **found them.** **barked.**

7. The hen jumped off the nest.
   In the nest there were twelve baby
   pigs. **birds.** **chickens.**

8. The big elephant blows water over the little elephant.
   The little elephant is taking his
   breakfast. **bath.** **supper.**

Part 5 Score
(number right)

Lee-Clark Reading Test®

First Reader • GRADES 1 and 2 • Form A

1958 REVISION

DEVISED BY J. MURRAY LEE AND WILLIS W. CLARK

Name .... Last .... First .... Middle .... Grade .... (Circle one) Boy Girl

School .... City .... Date of Test .... Month Day Year

Examiner .... ( ) Pupil's Age .... Date of Birth .... Month Day Year

See MANUAL for instructions.

Part	Section	Possible Score	Pupil's Score
PART 1	Auditory Stimuli	15	
PART 2	Visual Stimuli	15	
PART 3	Following Directions	12	
PART 4	Completion	9	
PART 5	Inference	8	
TOTAL TEST		59	

Grade Placement

Age Equivalent (in months)

PROFILE
(Chart Pupil's Scores Here)

Group I: 4 5 6 7 8 9 10 11 12 13 14-15 16-18 19-22 23-25 26-27 28 29-30 31-32 33-34 35 36 37 38-40 41-43 44-45 46

Group II: 4 5 6 7-8 9-10 11-12 13-15 16-19 20-22 23-25 26-28 29-31 32-34 35-38 39-41 42-44 45-47 48-49 50-51 52 53 54 55 56 57 58

1.0 1.5 2.0 2.5 3.0 3.5

72-73 74 75-76 77 78 79 80-81 82 83-84 85 86 87 88-89 90 91 92 93-94 95 96-97 98 99 100 101-2 103 104 105

First Reader • GRADES 1 and 2 • Form B

Lee-Clark Reading Test

1958 REVISION

DEVISED BY J. MURRAY LEE AND WILLIS W. CLARK

12th Printing

PUBLISHED BY CALIFORNIA TEST BUREAU, A DIVISION OF McGRAW-HILL BOOK COMPANY, DEL MONTE RESEARCH PARK, MONTEREY, CALIFORNIA —

PART 1

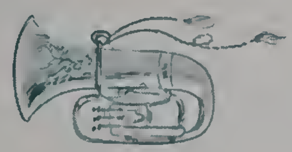
	boy	girl	the	at
	try	how	an	ears
1.	eat	roll	let	open
2.	rat	please	coat	great
3.	green	black	pink	red
4.	another	ate	again	about
5.	hid	hill	hide	here
6.	stamp	shelf	store	seeds
7.	flower	much	bird	many
8.	grew	blow	grow	flew
9.	cents	churn	cotton	cloth
10.	while	weeks	warm	wise
11.	ten	three	twelve	two
12.	hungry	hurry	hand	hurt
13.	turned	washed	barked	sorted
14.	animals	anything	sometimes	something
15.	playground	postman	postmaster	package

Part 1 Score
(number right)

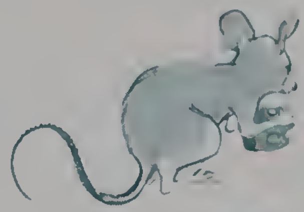
PART 2

boy

girl



1. rat



2. bread

3. horn

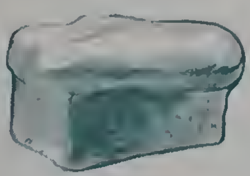
4. eyes

5. coat

12

6. twelve

7. pigs

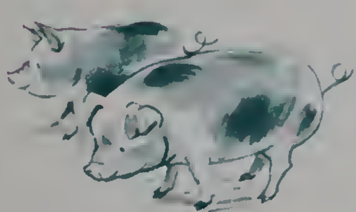


8. chickens

9. clock

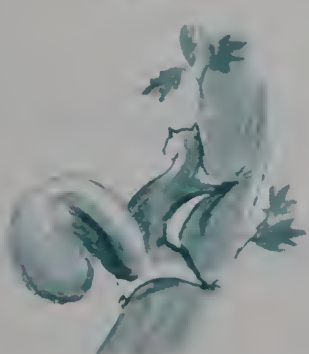
10. dress

11. spoon



12. airplane

13. sleep



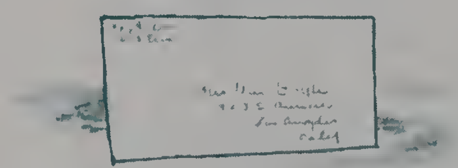
14. climbs

15. kick

Part 2 Score
(number right) ________


Make an **X** on the boy.
Make an **O** on the girl.

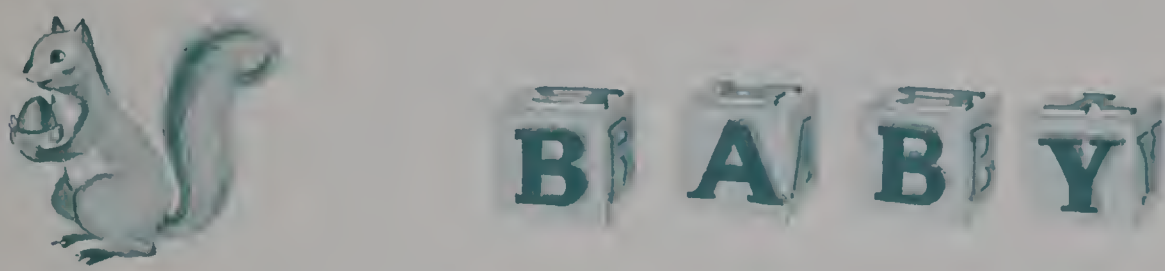

1. Make an **X** on the teeter-totter.
2. Make an **O** on the slide.



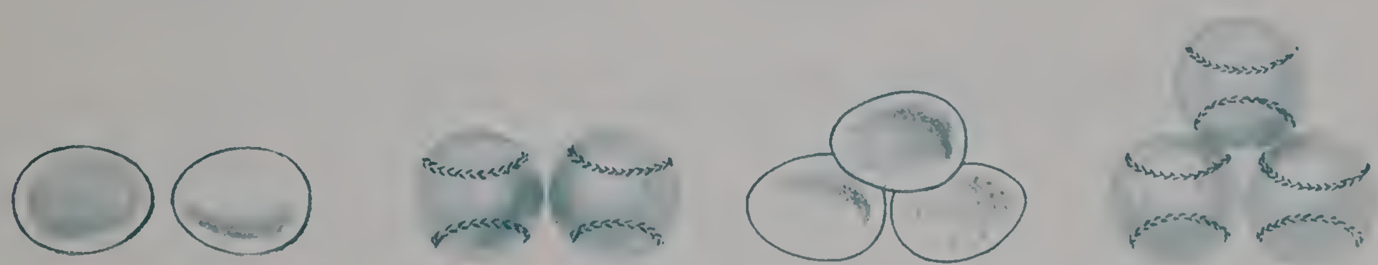

3. Draw a stamp on the package.
4. Draw a line under the letter.



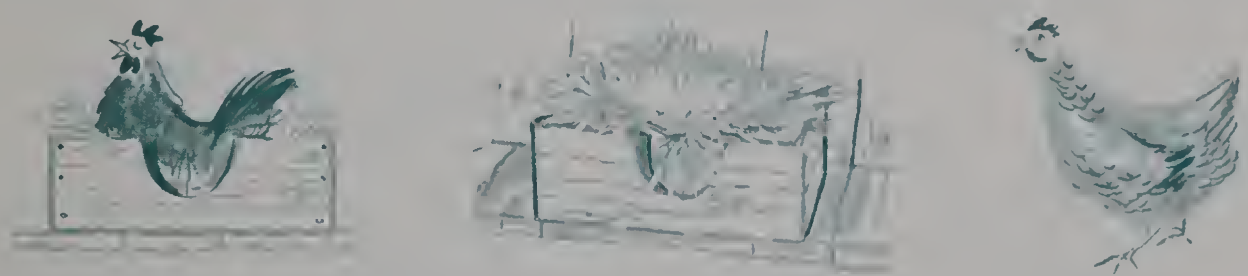
5. Draw a line from the robin to the grass.
6. Draw an egg in the nest.



7. Put an **X** on the block that has **A** on it.
8. Put an **X** on the squirrel's tail.



9. Draw a line under the two eggs.



10. Draw a line under the hen that is off the nest.

11. Put an **X** on the big elephant.
12. Put an **O** on the elephant in the water.

Part 3 Score
(number right) .....

PART 4

The dog sat on the

showed. steps. other.

1. The man carried the

   full. weighed. letters.

2. Jack had a talk with

   night. Santa. visit.

3. The poor kitty has paper tied to her

   feet. hurry. try.

4. The mice peeped out of their

   hung. began. holes.

5. On the farm they fed the

   fence. supper. cows.

6. The thread was made at the

   cloth. opened. mill.

7. The elephant blows water out of his

   swim. trunk. while.

8. The little elephant comes to the bank when his mother

   calls. live. thing.

9. The little ducks were frightened by the

   snake. faster. bright.

Part 4 Score (number right) ____

PART 5

1. Jack and Jane made butter.
   They made it from
   horses. **cream.** **bread.**

2. The hummingbird flew to a flower.
   He put in his bill and
   drank. **sang.** **flew.**

3. Jane went to the toy store.
   She liked the
   milk. **snow man.** **dolls.**

4. The toys came to the party.
   The little train said,
   "Choo-choo." "Bow-wow." "Ma-ma."

5. When the big dog came in,
   the cat was
   sick. **afraid.** **hungry.**

6. Donald saw the cows running at him.
   He and Jack
   played. **ran.** **painted.**

7. The hen sits on the nest.
   She will soon be the mother of some baby
   pigs. **birds.** **chickens.**

8. The big elephant jumps into the river.
   The big elephant is taking a
   ball. **swim.** **banana.**

Part 5 Score
(number right) ______

Lee-Clark Reading Test

First Reader • GRADES 1 and 2 • Form B

1957 REVISION

EVISED BY J. MURRAY LEE AND WILLIS W. CLARK

Name ________ Last ________ First ________ Middle   Grade ________ Boy Girl (Circle one)

School ________ City ________ Date of Test ________ Month Day Year

Examiner ________ ( ) Pupil's Age ________ Date of Birth ________ Month Day Year

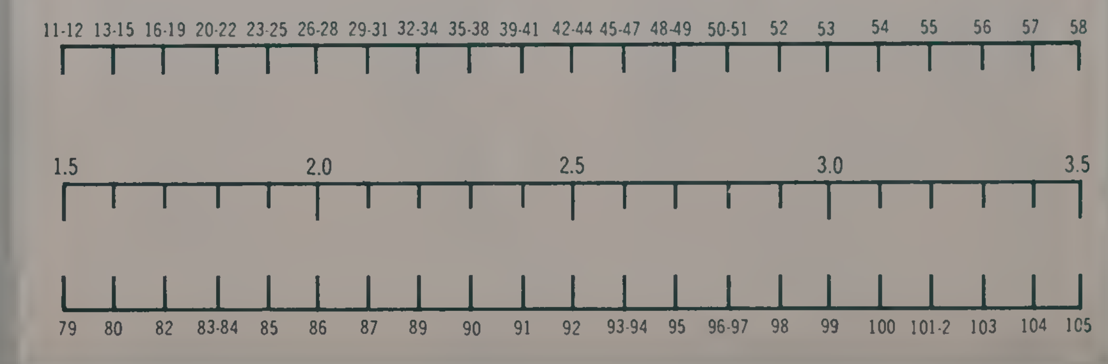
See MANUAL for instructions.

Part — Section	Possible Score	Pupil's Score
PART 1—Auditory Stimuli	15	
PART 2—Visual Stimuli	15	
PART 3—Following Directions	12	
PART 4—Completion	9	
PART 5—Inference	8	
TOTAL TEST	59	

Grade Placement ________

Age Equivalent (in months) ________

PROFILE
(Chart Pupil's Scores Here)



Published by CALIFORNIA TEST BUREAU, a Division of McGraw-Hill Book Company, Del Monte Research Park,

1963 S-FORM LEVEL 1

CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

DEVISED BY ELIZABETH T. SULLIVAN, WILLIS W. CLARK, AND ERNEST W. TIEGS

TO BOYS AND GIRLS:

This booklet has some games you will enjoy. Each game will show how well you can think. Do as much as you can in each game.

Do not turn this page until told to do so.

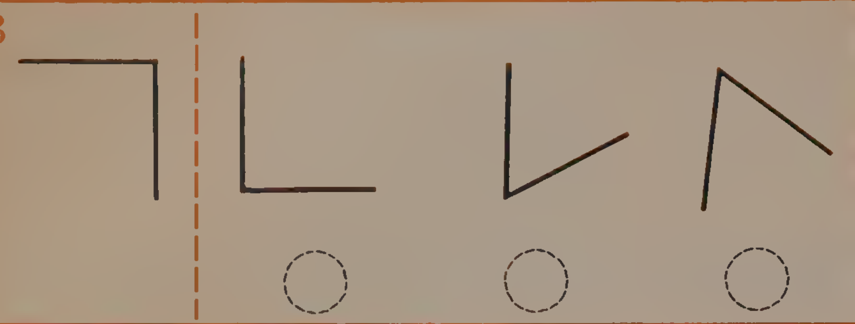
12TH PRINTING

CTB

PUBLISHED BY CALIFORNIA TEST BUREAU / A DIVISION OF McGRAW HILL BOOK COMPANY, DEL MONTE RESEARCH PARK, MONTEREY, CALIFORNIA

TEST 1

A


B


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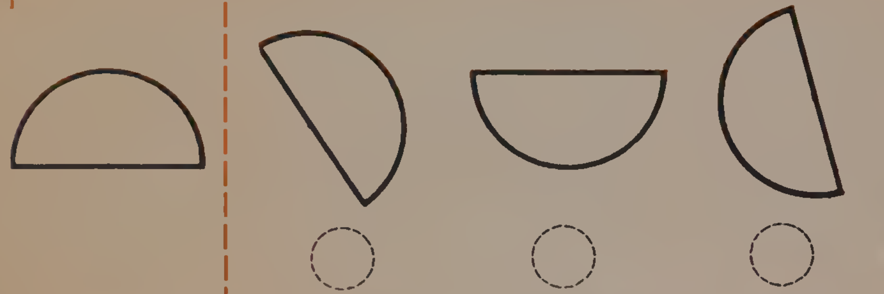

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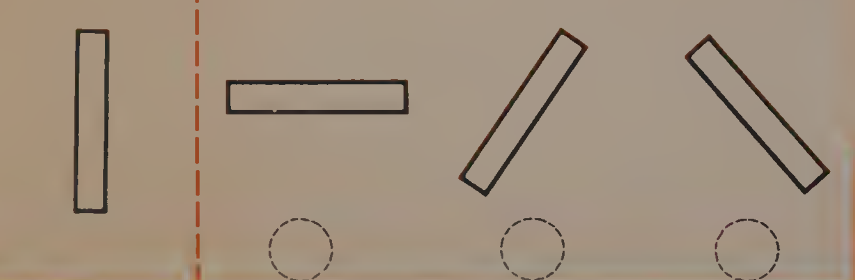
4


5


6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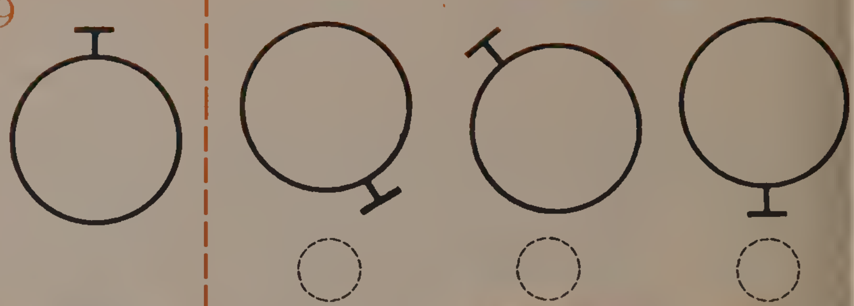
9


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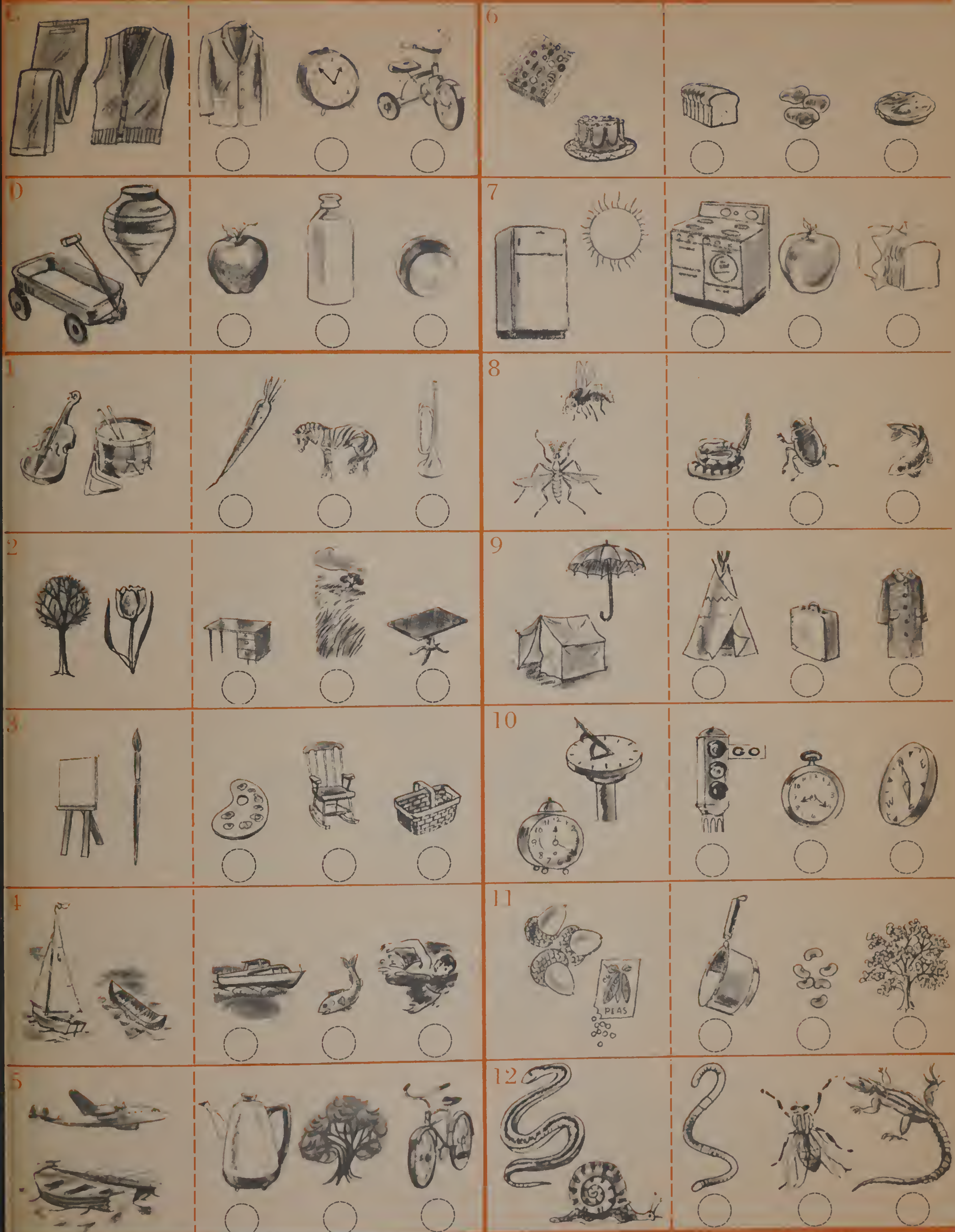
12


TEST 1 SCORE (number right) . . .

TEST 2



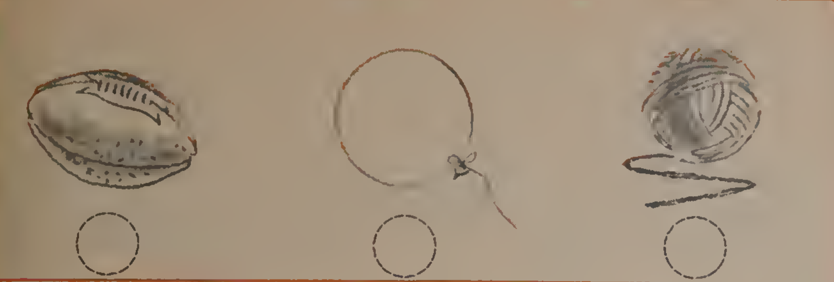
TEST 2 SCORE
number right

TEST 3

TEST 3 SCORE (number right) ____

TEST 4

G


1


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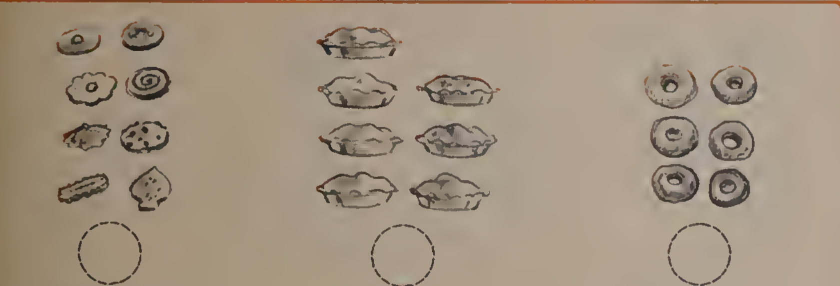

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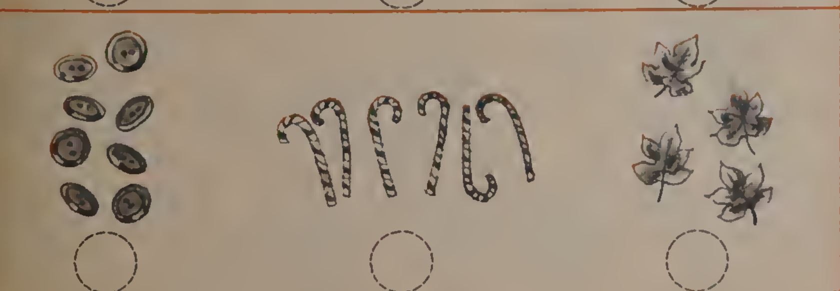

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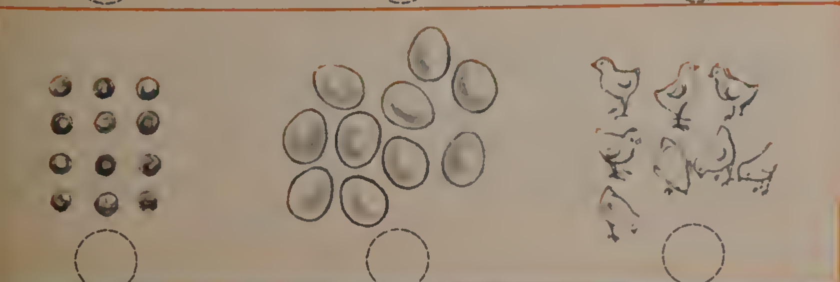

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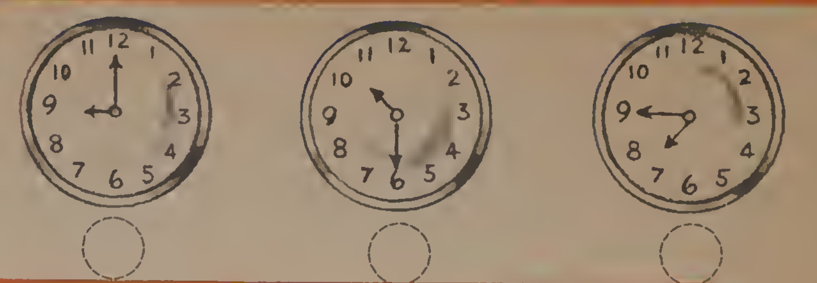

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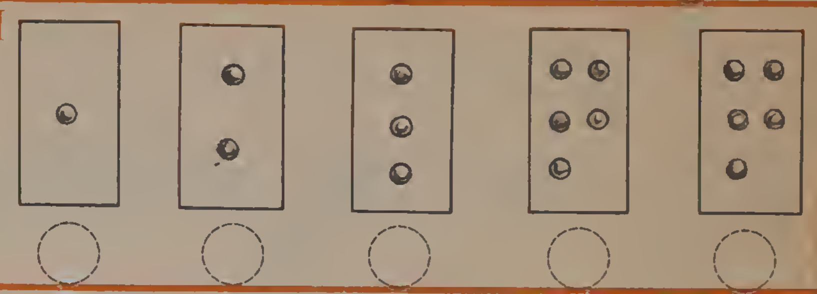

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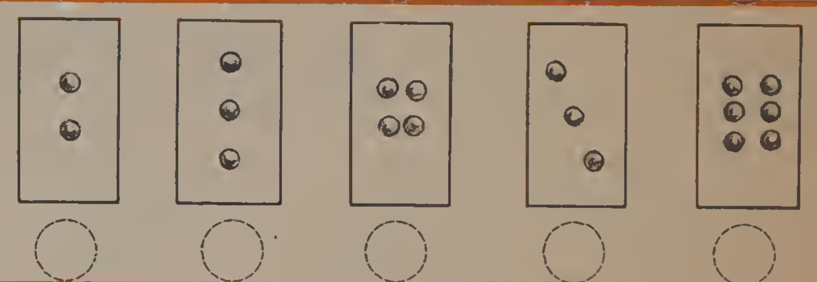

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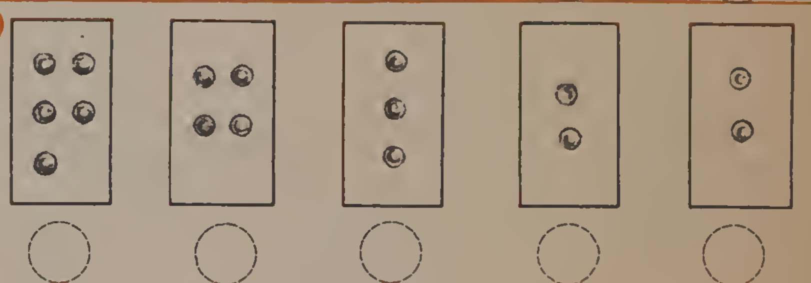

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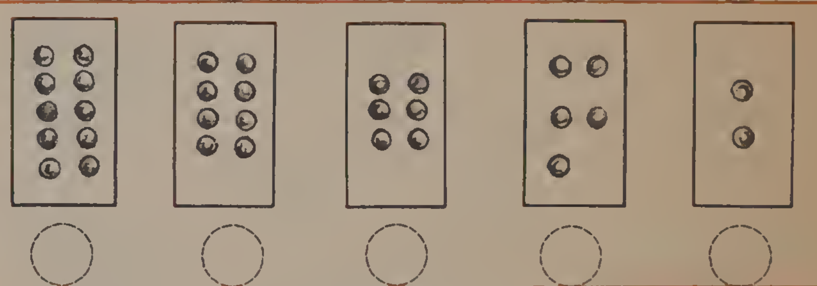

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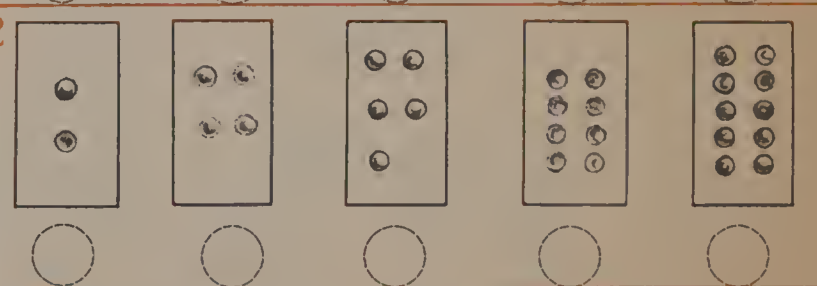

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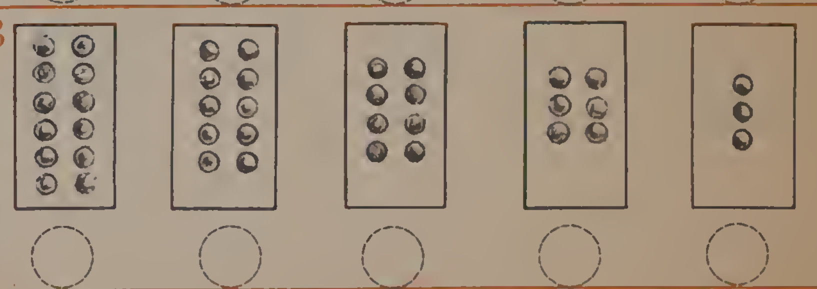

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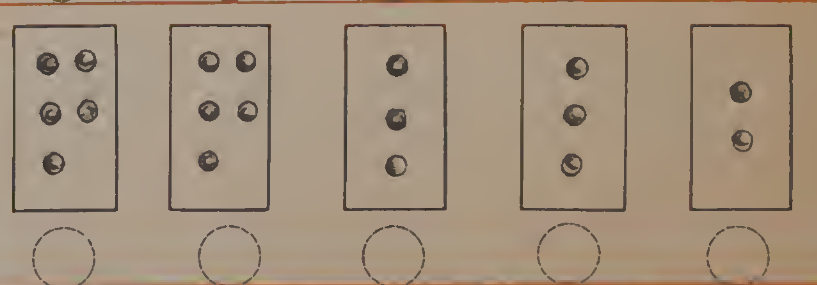
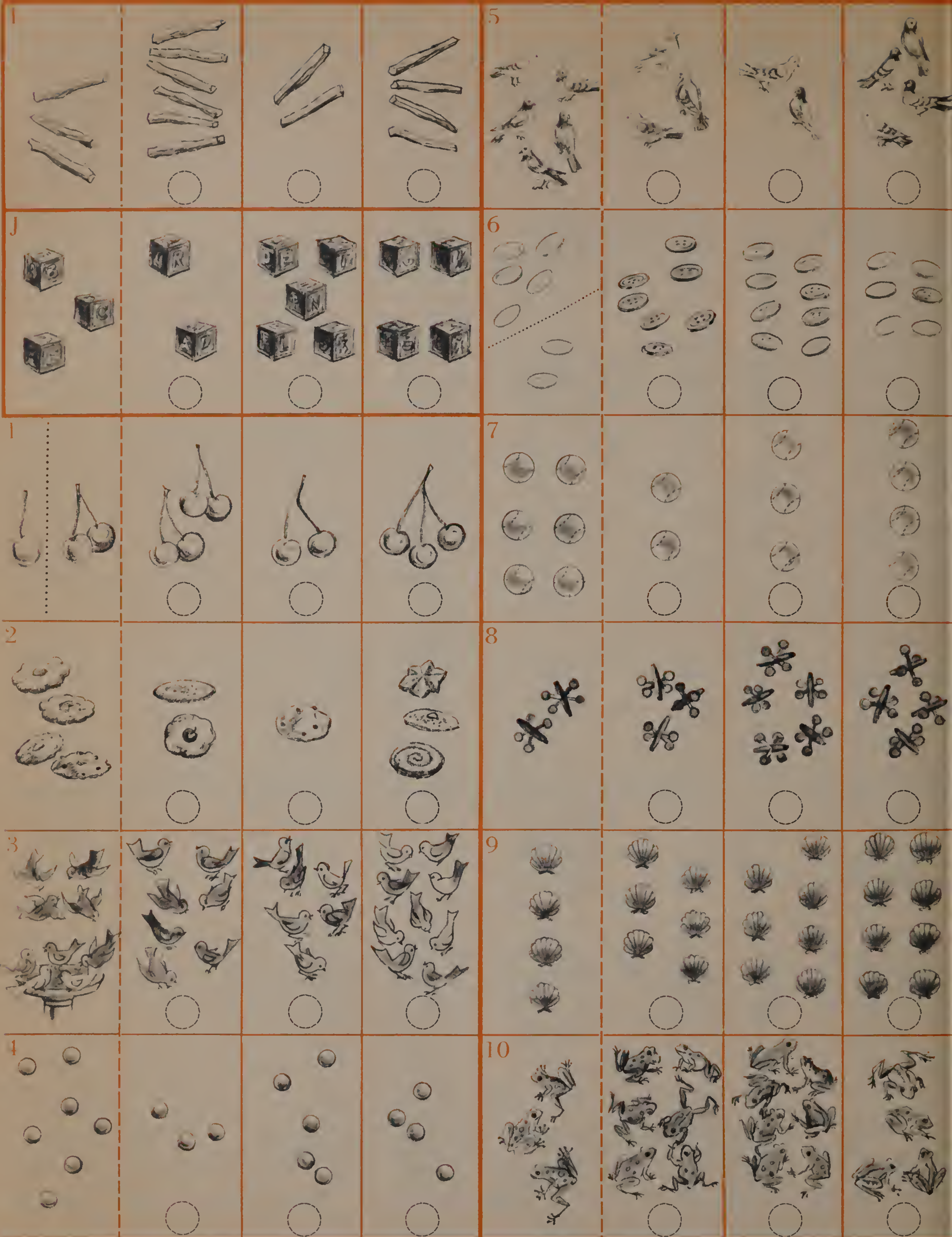


TEST 4 SCORE (Number right)

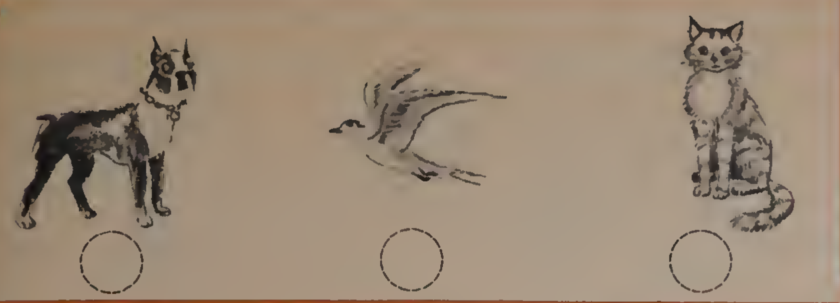
TEST 5



TEST 5 SCORE
(number right)

TEST 6

K



L

1

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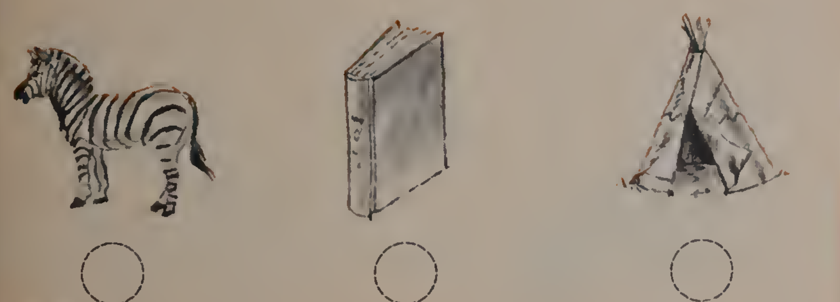

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25

TEST 6 SCORE (number right)

TEST 7

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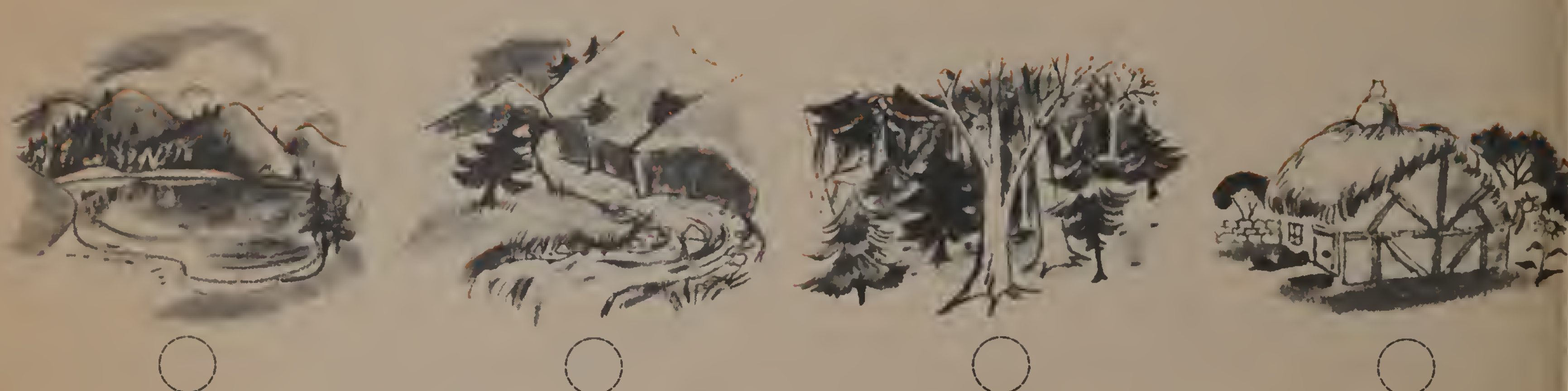


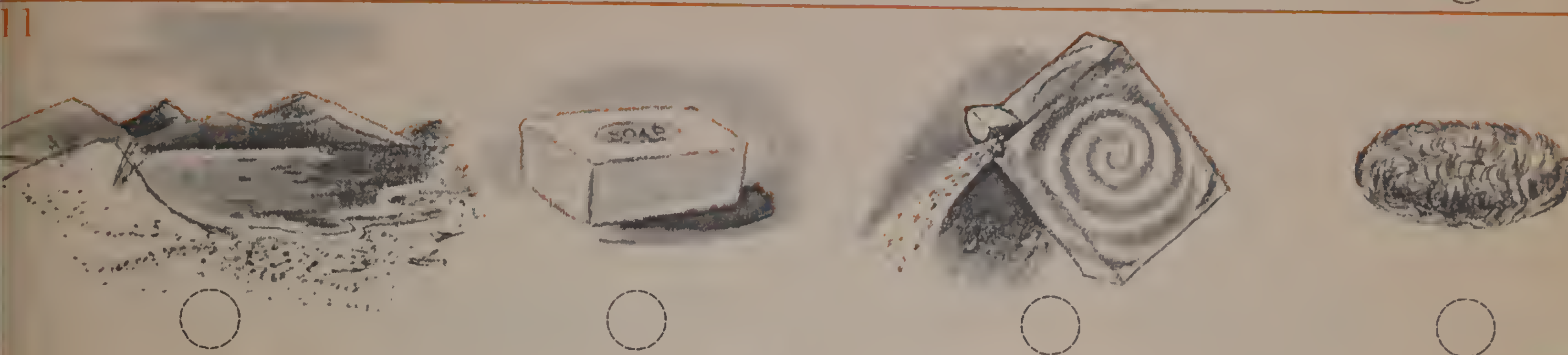
8

9

TEST 7 (Continued)

10

11



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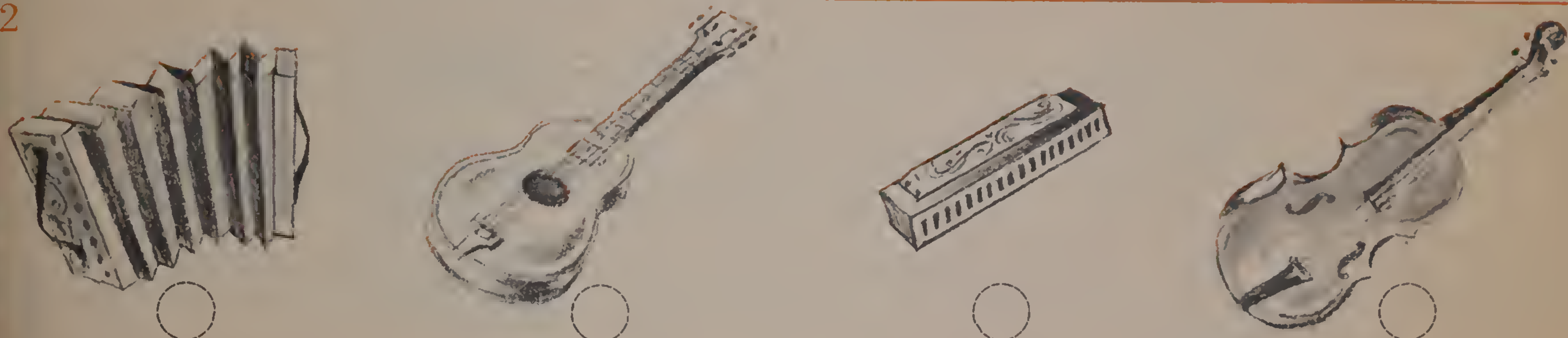

13

14

15

TEST 7 SCORE (number right)

CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

1963 S-FORM/LEVEL 1

REVISED BY E. T. SULLIVAN, W. W. CLARK, AND E. W. TIEGS

Name .... Last .... First .... Middle

School .... City ....

Boy Girl (Circle one) Grade .... Teacher or Examiner ....

Date of Test .... Year .... Month .... Day

Date of Birth .... Year .... Month .... Day

C.A. .... Years .... Months ( ) Total Mos.

TEST/FACTOR	1. OPPOSITES	2. SIMILARITIES	3. ANALOGIES	**I. LOGICAL REASONING**	4. NUMERICAL VALUES	5. NUMBER PROBLEMS	**II. NUMERICAL REASONING**	**III. VERBAL CONCEPTS** (6. VERBAL COMPREHENSION)	**IV. MEMORY** (7. DELAYED RECALL)	LANGUAGE (Tests 5, 6, 7)	NON-LANGUAGE (Tests, 1, 2, 3, 4)	TOTAL	I.S.I.†
POSSIBLE SCORE	12	12	12	36	14	10	24	25	15	50	50	100	
RAW SCORE													ACTUAL G.P.
PERCENTILE*													GRADE C.A.

	LANGUAGE	NON-LANGUAGE	TOTAL
M.A.‡			
RAW SCORE			
I.Q.‡